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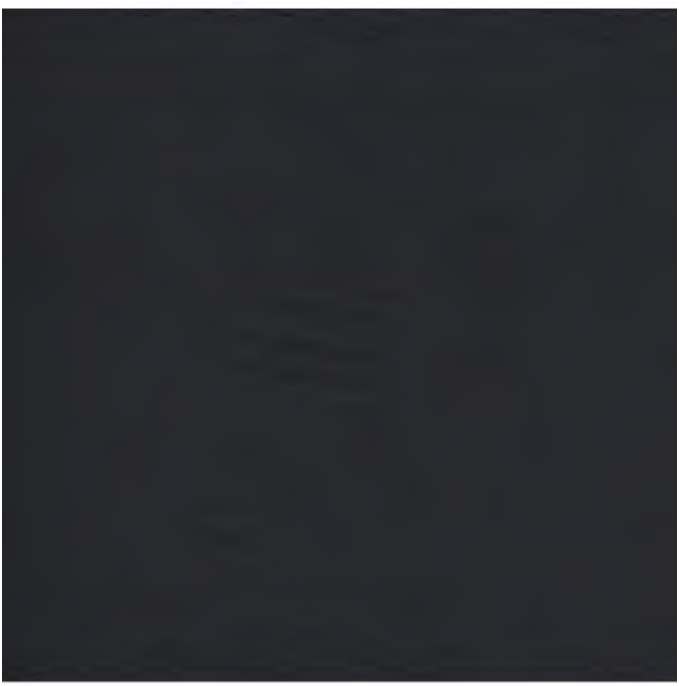

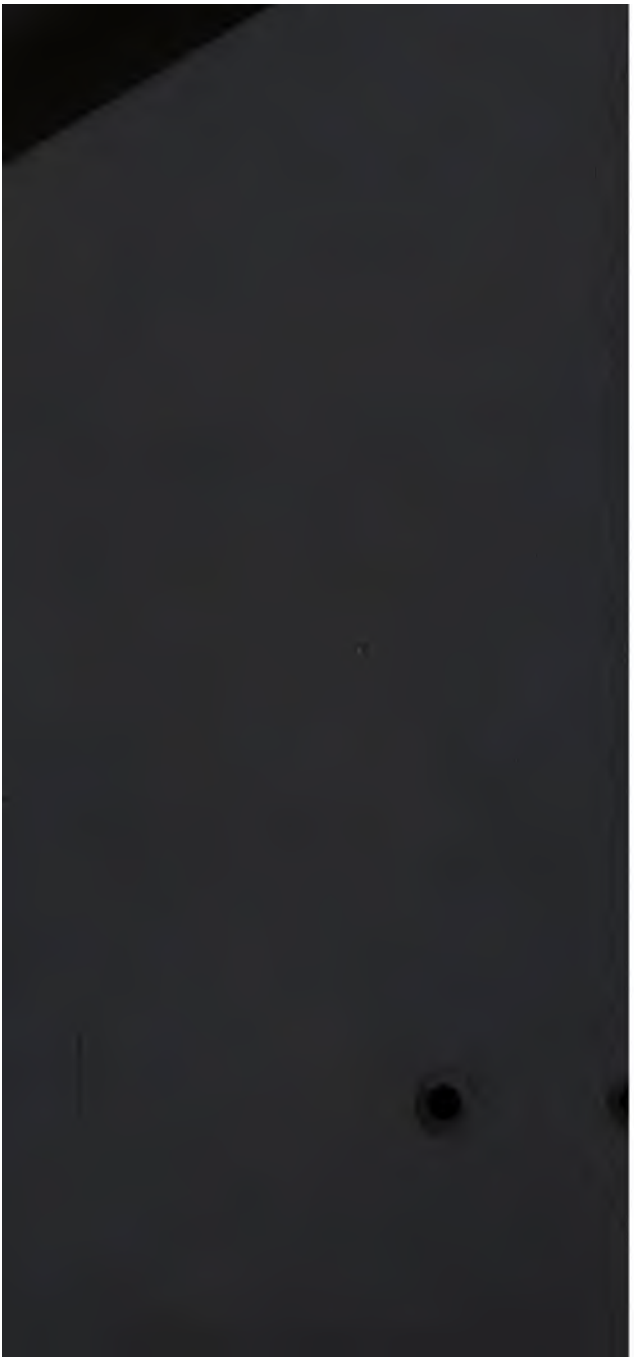

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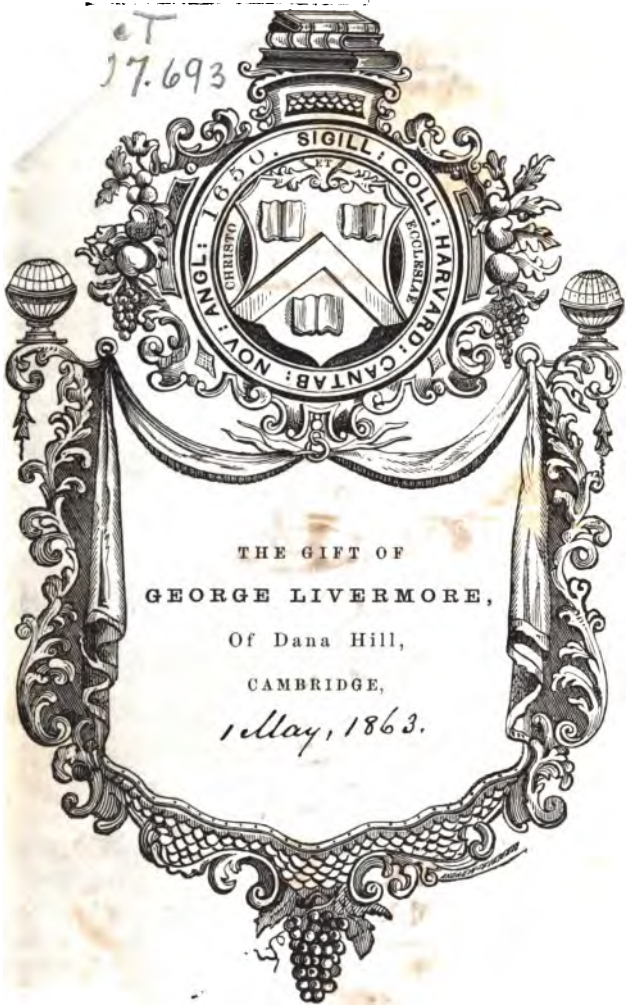

THE GIFT OF
GEORGE LIVERMORE,
Of Dana Hill,
CAMBRIDGE,
1 May, 1863.

THE

NEW COMPLETE SYSTEM

OF

ARITHMETICK,

COMPOSED FOR

THE USE OF THE CITIZENS OF THE UNITED STATES.

BY NICHOLAS PIKE, A. M.
Member of the American Academy of Arts and Sciences.

Abridged for the Use of Schools.

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George Lawrence, of Cambridge

DISTRICT OF MASSACHUSETTS, *to wit.*

L.S. *BE it Remembered,* That on the ninth day of *January,* in the thirty-first year of the Independence of the U. S. A. THOMAS & ANDREWS, of the said District, have deposited in this Office the title of a Book, the right whereof they claim as Proprietors, in the words following *to wit:* "The new complete System of Arithmetick, composed for the use of the citizens of the United States. By NICHOLAS PIKE, A. M. Member of the American Academy of Arts and Sciences—Abridged for the use of Schools."

In conformity to the act of the Congress of the United States, entitled "An act for the encouragement of Learning by securing the copies of Maps, Charts and Books to authors and proprietors of such copies, during the times therein mentioned;" and also to an act entitled "An Act supplementary to an act, entitled an act for the encouragement of Learning, by securing the copies of maps, charts and books to the authors and proprietors of such copies during the times therein mentioned; and extending the benefits thereof to the arts of designing, engraving, and etching historical and other prints."

WILLIAM S. SHAW, } *Clerk of the District of Massachusetts.*

Eric T. 118.07.693

EXPLANATION *of* CHARACTERS *used in this* TREATISE.

= THE sign of Equality: As 12 pence = 1 Shilling, signifies that 12 pence are equal to 1 Shilling; and in general that whatever precedes it is equal to what follows

\+ The sign of Addition: As 5+5=10, that is, 5 added to 5 is equal to 10.—Read 5 plus 5, or 5 more 5 equal to 10.

— The sign of Subtraction: As 12—4=8, that is 12 lessened by 4 is equal to 8, or 4 from 12 and 8 remains.—Read 12 minus, 4, or 12 less 4 equal to 8.

× The sign of Multiplication: As, 6×5=30, that is, 6 multiply by 5 is equal to 30.—Read 6 into 5 equal 30.

÷ or 6)30(The sign of Division: As, 30÷5=6 that is 30 divided by 5 is equal to 6.—Read 30 by 5 is equal to 6.

$\frac{875}{25}$ Numbers, placed fractionwise, do likewise denote division, the numerator or upper number being the dividend, and the denominator or lower number, the divisor thus, $\frac{875}{25}$. is the same as 875÷25=35.

: :: : The sign of Proportion, thus, 2 : 4 :: 8 : 16, that is As, 2 is to 4 so is 8 to 16.

$\overline{9-2+6}=13$ Shews that the difference between 2 and 9 added to 6 is equal to 13—Read 9 minus 2 plus 6 equal to 13; and that the line atop (called a Vinculum) connects all the numbers over which it is drawn.

$12-\overline{3+5}=4$ Signifies that the sum of 3 and 5 taken from 12, leaves or is equal to 4.

$-|^2$ Signifies the second Power or Square.

$-|^3$ *Signifies* the third Power or Cube.

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Pike's Arithmetick

ABRIDGED.

ARITHMETICK is the Art or Science of computing by numbers, and is compriſed under five principal or fundamental Rules, viz. NOTATION or NUMERATION, ADDITION, SUBTRACTION, MULTIPLICATION and DIVISION.

NUMERATION

Teaches the different value of figures by their different places and to read or write any ſum or number by theſe ten characters, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.—0 is called a cypher, and all the reſt are called figures or digits.

2. Beſides the ſimple value of figures as above noted, they have each a local value, according to the following law; viz. In a combination of figures, reckoning from right to left, the figure, in the firſt place repreſents its primitive ſimple value; that in the ſecond place, ten times its ſimple value, and ſo on; the value of the figure, in each ſucceeding place, being ten times the value of it, in that immediately preceding it.

3. The values of the places are eſtimated according to their order: the firſt is denominated the place of units; the ſecond, tens; the third, hundreds, and ſo on, as in the Table. Thus, in the number 3467: 7 in the firſt place, ſignifies only ſeven; 6 in the ſecond place, ſignifies 6 tens, or ſixty; 4, in the third place, four hundred; 3, in the fourth place, three thouſand; and the whole, taken together, is read thus; three thouſand four hundred and ſixty ſeven.

4. A cypher, though of no ſignification itſelf, yet it poſſeſſes a place, and when ſet on the right hand of figures, in whole numbers, increaſes their value in the ſame tenfold proportion; thus, 9 ſignifies only nine; but, if a cypher is placed on its right hand, thus, 90, it then becomes ninety.

To enumerate any parcel of figures, obſerve the following Rule.

Firſt. Commit the words at the head of the Table viz. units, tens, hundreds, &c. to memory; then, to the ſimple value of each figure, join, the name of its place, beginning at the left hand, and reading towards the right—*More particularly*—1. Place a dot under the right hand figure of the 2d, 4th, 6th, 8th, &c. half periods, and the figure over ſuch dot will, univerſally, have the name of thouſands.—2. Place the figures 1, 2, 3, 4, &c. as indices, over the 2d, 3d, 4th, &c. period: Theſe indices, will then ſhow the number of times the millions are involved—the figure under 1, bearing the name of millions, that under 2, the name of billions (or millions of millions) that under 3, trillions (or millions of millions of millions.)

EXAMPLE.

Sextill.		Quintill.		Quatrill.		Trillions.		Billions.		Millions.		Units.		
th.	un.	th.	un.	th.	un.	th.	un.	th.	un.	th.	un.	c.	x.	t.	c.	x.	u.
	6		5		4		3		2		1						
913,	208;	000,	341,	620,	057;	219,	356;	809,	379;	120,	406;	129,	7	6	8		
Thouſands		Thouſands		Thouſands		Thouſands		Thouſands		Thouſands		Thouſands					

NOTE

NOTE 1. Billions is ſubſtituted for millions of millions; Trillions, for millions of millions of millions: Quatrillions, for millions of millions of millions of millions.

Quintillions, Sextillions, Septillions, Octillions, Nonmillions Decillions, Undecillions, Duodecillions &c. anſwer to millions ſo often involved as their indices reſpectively denote.

NOTE 2. The right hand figure of each half period has the place of units, of that half period; the middle one, that of tens, and the left hand one, that of hundreds.

THE APPLICATION.

Write down, in proper figures, the following numbers.

Fifteen.
Two hundred and ſeventy-nine.
Three thouſand, four hundred and three.
Thirty-ſeven thouſand, five hundred and ſixty ſeven.
Four hundred, one thouſand and twenty eight.
Nine millions, ſeventy two thouſand and two hundred.
Fifty five millions, three hundred nine thouſand and nine.
Eight hundred millions, fourty four thouſand, and fifty five.
Two thouſand, five hundred and forty three millions, four hundred and thirty one thouſand, ſeven hundred and two.

Write down in words at length, the following numbers.

8	437	709040	3476194	7584397647
17	3010	879066	84094007	49163189186
129	76506	4091875	690748591	500098422700

Notation by Roman Letters.

I. One.	XL. Forty.
II. Two.	L. Fifty.
III. Three.	LX. Sixty.
IV. Four.	LXX. Seventy.
V. Five.	LXXX. Eighty.
VI. Six.	XC. Ninety.
VII. Seven.	C. Hundred.
VIII. Eight.	CC. Two Hundred.
IX. Nine.	CCC. Three Hundred.
X. Ten.	CCCC. Four Hundred.
XI. Eleven.	D or IↃ. Five Hundred.
XII. Twelve.	DC. Six Hundred.
XIII. Thirteen.	DCC. Seven Hundred.
XIV. Fourteen.	DCCC. Eight Hundred.
XV. Fifteen.	DCCCC. Nine Hundred.
XVI. Sixteen.	M or ĆIↃ. One Thouſand.
XVII. Seventeen.	IↃↃ. Five Thouſand.
XVIII. Eighteen.	IↃↃↃ. Fifty Thouſand.
XIX. Nineteen.	IↃↃↃIↃↃↃ. Five hund. thou.
XX. Twenty.	MDCCCVII. One thouſand eight hundred and ſeven.
XXX. Thirty.	

A leſs literal number, placed after a greater, always augments the value of the greater; if put before, it diminiſhes it. Thus, VI is 6; IV is 4; XI is 11; IX is 9, &c.

ADDITION

Is the putting together of two or more numbers, or ſums, to make them one total, or whole ſum.

SIMPLE ADDITION

Is the adding of ſeveral integers or whole numbers together, which are all of one kind, or ſort; as, 7 pounds, 12 pounds and 20 pounds, being added together, their aggregate, or ſum total, is 39 pounds.

RULE.

SUBTRACTION

Teaches to take a leſs number from a greater, to a third, ſhewing the inequality, exceſs or differenc tween the given numbers; and it is both ſimple compound.

SIMPLE SUBTRACTION

Teaches to find the difference between any two bers, which are of a like kind.

RULE.

Place the larger number uppermoſt, and the leſ derneath, ſo that units may ſtand under units, tens u tens, &c. then, drawing a line underneath, begin the units, and ſubtract the lower from the upper fi and ſet down the remainder; but if the lower figu greater than the upper, borrow ten and ſubtract lower figure therefrom: To this difference, add th per figure, which, being ſet down, you muſt add o the ten's place of the lower line, for that which borrowed; and thus proceed through the whole.

PROOF.

In either ſimple, or compound Subtraction, add remainder and the leſs line together, whoſe ſum, if work be right, will be equal to the greater line:— ſubtract the remainder from the greater line, and difference will be equal to the leſs.

EXAMPLE

EXAMPLES.

	1. £.	2. £.	3. Miles.	4. Yards.	5. Feet.	6. Cwt.
From	25	305	4670	58934	879647	9187641
Take	12	103	4020	6182	164348	91843
Rem.						
Proof.						

7.	8.	9.
1002003004005006007008009000	10000	1000000
98076054032011023045067089	9999	1

MULTIPLICATION.

Many be accounted the moſt ſerviceable Rule in Arithmetic; it teaches how to increaſe the greater of two numbers given, as often as there are units in the leſs; performs the work of many additions in the moſt compendious manner; brings numbers of great denominations into ſmall, as pounds into ſhillings, pence, or farthings, &c. and by knowing the value of one thing, we find the value of many.

It conſiſts of three parts.

1. The Multiplicand, or number given to be multiplied, and commonly, the largeſt number.

2. The Multiplier, or number to multiply by, commonly, the leaſt number.

3. The product is the reſult of the work, or the anſwer to the queſtion.

SIMPLE

SIMPLE MULTIPLICATION

Is the multiplying of any two numbers together, without having regard to their ſignification; as, 7 times 8 is 56, &c.

MULTIPLICATION *and* DIVISION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

To learn this Table, for Multiplication: Find your multiplier in the left hand column, and your multiplicand atop, and in the common angle of meeting, or againſt your multiplier, along at the right hand, and under your multiplicand, you will find the product, or anſwer.

To learn it, for Diviſion: Find the diviſor in the left hand column, and run your eye along the row to the right hand until you find the dividend; then, directly over the dividend atop, you will find the quotient, ſhowing how often the diviſor is contained in the dividend.

CASE I.

When the multiplier is not more than 12, always placing the greateſt number uppermoſt, ſet the multiplier underneath, units under units, &c. and begin as the Table directs, ſetting down the unit figure under units, and carrying the tens to the next place, in all reſpects as in ſimple addition.

PROOF.

Multiply the multiplier by the multiplicand.

EXAMPLES.

1.	2.	3.	4.
37934	769308	4980076	763896
2	3	4	5
Prod.			

5.	6.	7.	8.
67589	503764	3918295	9164785
6	7	8	9

9.	10.	11.
4879567	5864734	8593478649
10	11	12

CASE II.

When the multiplier is of more places than 12, multiply each figure in the multiplicand by every figure in the multiplier, beginning with the units, and placing the firſt figure of each product exactly under its multiplier. *Laſtly*, add theſe ſeveral products together, in the ſame

same order as they stand, and their sum will be t
total product.

EXAMPLES.

1.	2.	3.
6357534	8324629	4629384
47	59	7
44502738		
25430136		
Prod. 2988[illegible]98		

4.	5.	6.
647906	760483	9186758
4873	9152	687
3157245938	6959940416	6315896400

CASE III.

When the multiplier is a compoſite number, tha
when it is produced by the multiplication of any
numbers in the Table, multiply the multiplicand by
of thoſe figures firſt, and that product by the ot
And the laſt product will be the total required.

EXAMPLES.

1.	2.	3.
Mult. 59375 by 35.	80187 by 48.	91632 by

7
7X5=35
4156625
5
20781125

	4.	5.	6.
Mult.	91738 by 81.	35963 by 72.	847396 by 99.

	7.	8.	9.
Mult.	38462 by 108.	749357 by 121.	9043278 by 144.

CASE IV.

When there are cyphers on the right hand of, either the multiplicand, or multiplier, or both, neglect those cyphers: then place the significant figures under one another, and multiply by them only; add them together, as before directed, and place to the right hand as many cyphers as there are in both the factors.

Examples.

	1.	2.	3.
	67910	956700	930137000
	5600	320	9500
Prod	380296000	306144000	8836301500000

	4.	5.	6.
	359260	8196000	623000
	7364	59180	589000
Prod.	2645590640	485039280000	366947000000

CASE V.

When there are cyphers between the significant figures of the multiplier, omit multiplying by them, and place the first figure of each product of the significant figures, exactly under that figure by which you multiply; lastly, add them together, and their sum will be the total product.

Examples.

EXAMPLES.

	1.	2.	4.
	5397	85630	4897685
	9009	7005	400030
	48573		
	43176		
Prod.	43224573	599838150	1959220930500

CASE VI.

To multiply by 10, 100, 1000, &c. set down the multiplicand underneath and join the cyphers in your multiplier to the right hand of them.

EXAMPLES.

1.	2.	3.	4.
57935	84935	613975	8473965
10	100	1000	10000
Prod.			

CASE VII.

To multiply by 99, 999, &c. in one line; place as many dots at the right hand of the multiplicand, as there are figures of 9 in your multiplier, which dots suppose to be cyphers; then, beginning with the right hand dot, subtract the *given* multiplicand from the *new* one, and the remainder will be the total product.

EXAMPLES.

Mult.	371967...	According to the Rule it will stand thus,	371967...	Minuend.
by	999		371967	Subtrah.
	371595033		371595033	Rem. or total Prod.

CASE

CASE VIII.

To multiply by 13, 14, 15, &c. to 19: Place your multiplier at the right of the multiplicand, with the sign of multiplication between them, and multiply with the unit figure, only, of the multiplier, removing the product one figure to the right hand of the multiplicand; then add all together, and their sum will be the total product.

EXAMPLES.

1.	2.	3.
75964X13	7598X14	76013X15
227892		
Prod. 987532		

4.	5.	6.
8196X16	3179X17	4679X19
Prod.		

CASE IX.

To multiply by 101, 102, 103, &c. to 109: Multiply by the right hand figure, only, of the multiplier, removing the product two figures to the right hand of the multiplicand: Add all together, and the sum will be the total product. In the same manner proceed with 1001, 1002, &c. removing the product three figures.

EXAMPLES.

EXAMPLES.

1. 64795 × 101 — 64795 — Prod. 6544295

2. 79164 × 102

3. 37598 × 103

4. 73967 × 104 — Prod.

5. 84973 × 105

6. 748794 × 106

7. 87958 × 107 — Prod.

8. 395867 × 108

9. 5916379 × 109

CASE X.

To multiply by 21, 31, 41, &c. to 91 : Multiply by the ten's figure, only, of the multiplier, and set the unit figure of the product under the place of tens ; add them all together, and their sum will be the total product.

EXAMPLES.

1. 73918 × 21 — 147836 — 1552278

2. 56934 × 31

3. 86789 × 41

4. 759846 × 51

5. 37954 × 61

6. 73958 × 71

DIVISION

10
10
100

DIVISION

Teaches to ſeparate any number, or quantity given, into any number of parts aſſigned; or to find how often one number is contained in another; or from any two numbers given to find a third, which ſhall conſiſt of ſo many units, as the one of thoſe given numbers is comprehended in the other; and is a conciſe way of performing ſeveral ſubtractions.

There are four principal parts to be noticed in Diviſion, viz.

1. The Dividend, or number given to be divided.

2. The Diviſor or number given to divide by.

3. The Quotient, or anſwer to the queſtion, which ſhows how often the diviſor is contained in the dividend.

4. The remainder (which is always leſs than the diviſor, and of the ſame name with the dividend) is very uncertain, as there is ſometimes a remainder, and ſometimes none.

Diviſion is both ſimple and compound.

PROOF.

Multiply the diviſor and quotient together, and add the remainder, if there be any, to the product: If the work be right, that ſum will be equal to the dividend.

SIMPLE DIVISION

Is the dividing of one number by another, without regard to their values: As, 56, divided by 8, produces 7 in the quotient: That is, 8 is contained 7 times in 56.

CASE

CASE I.*

RULE.

First, ſeek how many times the diviſor is contained in a competent number of the firſt figures of the dividend; when found, place the figure in the quotient; multiply the diviſor by this quotient figure; place the product under the left hand figures of the dividend; then ſubtract it therefrom, and bring down the next figure of the dividend to the right hand of the remainder: If, when you have brought down a figure to the remainder, it is ſtill leſs than the diviſor, a cypher muſt be placed in the quotient, and another figure be brought down; after which you muſt ſeek, multiply, and ſubtract, till you have brought down every figure of the dividend.

EXAMPLES.

* When there is no remainder to a diviſion, the quotient is the abſolute and perfect anſwer to the queſtion; but where there is a remainder, it may be obſerved, that it goes ſo much towards another time as it approaches the diviſor; thus, if the remainder be half the diviſor, it will go half of a time more, and ſo on; in order, therefore, to complete the quotient, put the laſt remainder to the end of it, above a line, and the diviſor below it.

It is ſometimes difficult to find how often the diviſor may be had in the numbers of the ſeveral ſteps of the operation: The beſt way will be to find how often the firſt figure of the diviſor may be had in the firſt, or two firſt figures of the dividend and the anſwer, made leſs by one or two, is generally the figure wanted; but if, after ſubtracting the product of the diviſor and quotient from the dividend, the remainder be equal to, or exceed, the diviſor, the quotient figure muſt be increaſed accordingly.

EXAMPLES.

Diviſor. Dividend. Quotient.

```
3)175817(58605
  15
  --
  25
  24
  --
  18
  18
  --
  17
  15
  --
   2 Rem.
```

Proof.

```
58605 Quotient.
   X3 Diviſor
  ----
+2
  ----
175817
```

In this example, I find that 3, the diviſor, cannot be contained in the firſt figure of the dividend; therefore, I take two figures, viz. 17, and inquire how often 3 is contained therein, which finding to be 5 times, I place the 5 in the quotient, and multiply the diviſor by it, ſetting the firſt figure of the multiplication under the 7 in the dividend, &c I then ſubtract 15 from 17, and find a remainder of 2, to the right hand of which, I bring down the next figure of the dividend, viz. 5; then, I inquire how often the diviſor 3 is contained in 25, and, finding it to be 8 times, I multiply by 8, and proceed as before, till I bring down the 1, when finding I cannot have the diviſor in 1, I place 0 in the quotient, and bring down 7 to the 1, and proceed as at the firſt.

Obſerve, that in multiplying by 3, I add in the 2.

EXAMPLES.

EXAMPLES.

2.

29)153598(5296
145

85
58

279
261

188
174

14

3.

6493)91867375(14150
6493

26946
25972

9743
6493

32507
32465

425

4.

28)503775(

5.

35)197184(

6.

85)994466(

7.

236)3798567(

8.

3479)48395795(

9.

5679)19647394(

10.

38473)119184693(

11.

641976)9187642959(

12.

5823789)791822376496(

13.

123456789)12193263111263526 9(

CASE II.

When there is one cypher, or more at the right hand of the divisor, it or they must be cut off; also cut off the same number of figures from the dividend, and then proceed as in case first: But the figures which were cut off from the dividend must be placed at the right hand of the remainder.

EXAMPLES.

EXAMPLES.

1.

65|00)37943261 75(58374
325
544
520
243
195
482
455
276
260
1675 Rem.

2.

5193|000)8937643|893(

3.

9170)476583(

4.

875000)9176478948000(

5.

Quot. Rem.
1|0)9584|6

6.

Quot. Rem.
1|00)76495|80

7.

Quot. Rem.
1|000)9375183|9462

NOTE. In dividing by 10, 100, 1000, &c. when you cut off as many figures from the dividend, as there are cyphers in the divisor, your work is done; those figures cut off at the right hand, are the remainder and those on the left, the quotient, as above.

CASE III.

Short Division is, when the divisor does not exceed 12.

RULE.

First, seek how often the divisor can be had in the first figure, or figures of the dividend; which, when found, place

place in the quotient; then, *mentally*, multiply your diviſor by the figure placed in the quotient, and ſubtract the product from the like number of the left hand figures of your dividend, and the units which remain muſt be accounted ſo many tens, which you muſt ſuppoſe to ſtand at the left hand of the next figure in the dividend, and to be reckoned with it; then, ſeek how often you can have your diviſor in thoſe two figures; but if nothing remain, you muſt then ſeek how often your diviſor is contained in the next figure, or figures, and thus proceed till you have done.

EXAMPLES.

Diviſor. Dividend.	2.	3.	4.
2)71935	3)51903	5)633795	6)8471937
Quot. 35967—1			

5.	6.	7.
8)5437846	9)45963784	11)91843756

CASE IV.

When the diviſor is ſuch a number, that any two, or more, figures in the table, being multiplied together, will produce it, divide the given dividend by one of thoſe figures; the quotient, thence ariſing, by the other, and ſo on; and the laſt quotient will be the anſwer.*

EXAMPLES.

* As the learner, at preſent, is ſuppoſed to be unacquainted with the nature of Fractions, and as the quotient is incomplete without the remainder—I ſhall here give a rule for finding the true remainder, without having recourſe to fractions.

RULE.

EXAMPLES.

First Method.	Second Method.
9)196473	8)196473
8)21830	9)24559
Quot. 2728—57	Quot. 2728—57

In the *first* operation, in dividing by 9, 3 remains, and by 8, 6 remains; which being the laſt remainder, I multiply it by the firſt diviſor 9, and add in the firſt remainder 3, and they make 57, the true remainder. In the *ſecond* method, dividing by 8, 1 remains, and by 9, 7 remains; I therefore multiply 7, the laſt remainder, by 8, adding in the 1, and they make 57, as before.

2.	3.	4.	5.
36)79638	25)197835	84)93975	54)9373864
6.	7.	8.	
121)75323939	132)38473692	144)891376429732	

Supplement to Contractions in Multiplication.

The ſhorteſt method of multiplication, when the multiplier is any even part of 100, 1000, &c. is by diviſion; for if the multiplicand be increaſed by a number of cyphers equal to the places in the multiplier, and a part of

RULE.

Multiply the quotient by the diviſor; ſubtract the product from the dividend, and the reſult will be the true remainder.

The Rule which is moſt commonly made uſe of, when the diviſor is a compoſite number, is,

RULE II.

Multiply the laſt remainder by the preceding diviſor, or laſt but one, and to the product add the preceding remainder; multiply this ſum by the next preceding diviſor, and to the product add the next preceding remainder; and ſo on till you have gone through all the diviſors and remainders, to the firſt.

of that product taken for the same proportion, which the multiplier bears to 1, and the same number of cyphers annexed to it, the quotient will be the product.

1. Mult 39756 into 125. 2. Mult. 57638 by 33⅓.

125=⅛ of 1000, wherefore, 33⅓=⅓ of 100, therefore,

8)39756000 3)5763800

4969500 Product. 1921266⅔ Prod.

TABLES IN COMPOUND ADDITION.

1. MONEY.

			Marked
4 Farthings	make 1	Penny.	qrs. d.
12 Pence		Shilling.	s.
20 Shillings		Pound.	£.

Farthings.

4 = 1 Penny.
48 = 12 = 1 Shilling.
960 = 240 = 20 = 1 Pound.

PENCE TABLES.

d.	s.	d.	d.	s.	d.
20 =	1	8	120 =	10	0
30 =	2	6	130 =	10	10
40 =	3	4	140 =	11	8
50 =	4	2	150 =	12	6
60 =	5	0	160 =	13	4
70 =	5	10	170 =	14	2
80 =	6	8	180 =	15	0
90 =	7	6	190 =	15	10
100 =	8	4	200 =	16	8
110 =	9	2			

s.	d.	s.	d.
1 =	12	11 =	132
2 =	24	12 =	144
3 =	36	13 =	156
4 =	48	14 =	168
5 =	60	15 =	180
6 =	72	16 =	192
7 =	84	17 =	204
8 =	96	18 =	216
9 =	108	19 =	228
10 =	120	20 =	240

2. TROY WEIGHT.*

			Marked.
24 Grains	make 1	Pennywt.	grs. pwt.
20 Pennyweights		Ounce.	oz.
12 Ounces		Pound.	℔ or lb.

3. AVOIRDUPOIS WEIGHT.†

				Marked.
16 Drams	make 1	1 Ounce.	dr.	oz.
16 Ounces		1 Pound.		lb.
28 Pounds		¼ of a hundred wt.		qr.
4 Quarters		100 wt. *or* 112 lbs.		Cwt.
20 Hund. wt.		1 Ton.		T.

4. APOTHECARIES'

* By this weight are weighed Gold, Silver, Jewels, Electuaries, and all Liquors.

NOTE. 175 Troy ounces are precisely equal to 192 Avoirdupois ounces, and 175 Troy pounds are equal to 144 Avoirdupois. 1lb Troy = 5760 grains, and 1lb Avoirdupois = 7000 grains.

† By Avoirdupois are weighed all coarse and drossy goods, grocery and chandlery wares; bread, and all metals, except Gold and Silver.

4. APOTHECARIES' WEIGHT.*

20 Grains	make 1	Scruple. *Marked*	gr. ℈
3 Scruples		Dram.	ʒ
8 Drams		Ounce.	℥
12 Ounces		Pound.	lb.

5. CLOTH MEASURE.

2¼ Inches	make 1	Nail. *Marked*	in. na.
4 Nails, or 9 Inches		Quarter of a yard.	qr.
4 Quarters, or 36 In.		Yard.	yd.
3 Quarters, or 27 In.		Ell Flemiſh.	E. Fl.
5 Quarters, or 45 In.		Ell Engliſh.	E. E.
6 Quarters, or 54 In.		Ell French.	E. Fr.
4 Qrs. 1 ⅕ In. or 37 In. and 1 fifth		Ell Scotch.	E. Sc.
3 Qrs. and 2 thirds		Spaniſh Var.	

6. LONG MEASURE.†

3 Barley corns	make 1	Inch. *Marked*	bar. in.
12 Inches		Foot.	ft.
3 Feet		Yard.	yd.
5½ Yds. or 16½ feet		Rod, Perch, or Pole.	pol.
40 Poles		Furlong.	fur.
8 Furlongs		Mile.	mile.
69½ Stat. miles, *nearly*		Degree of a great Circle.	deg.
360 Degrees		A great Circle of the earth.	

Or,

* All the weights now uſed by Apothecaries, above grains, are Avoirdupois.

The Apothecaries' pound and ounce, and the pound, and ounce Troy, are the ſame, only differently divided and ſubdivided.

† The uſe of Long Meaſure is to meaſure the diſtance of places or any other thing, where length is conſidered without regard to breadth.

NOTE

Or, in Measuring Distances,

7 9/10 Inches	make	1 Link.
25 Links		1 Pole.
100 Links		1 Chain.
10 Chains		1 Furlong.
8 Furlongs		1 Mile.

7. TIME.*

60 Seconds	make 1	Minute. *Marked*	s. m.
60 Minutes		Hour.	h.
24 Hours		Day.	d.
7 Days		Week.	w.
4 Weeks		Month.	mo.
13 Mo. 1 day & 6 hours		Julian Year.	yr.

8. LAND OR SQUARE MEASURE.

144 Inches	make 1	Square foot.
9 Feet		—— Yard.
30¼ Yards, or 272¼ Feet		—— Pole.
40 Poles		—— Rood.
4 Roods, or 160 Rods, or 4840 Yards		—— Acre.
640 Acres		—— Mile.

9. SOLID

NOTE 60 geometrical miles make a degree—4 inches a hand—5 feet a geometrical pace, 6 points make 1 line, 12 lines an inch, 12 inches a foot, and 6 feet 1 French toise, or fathom; equal to 6 feet 4 inches, 8,812875 lines, Engliſh meaſure. 1 Engliſh foot equal to 11 inches, 3,1154 lines French 66 feet, or 4 poles make a Gunter's chain. 3 miles make a league.

* By the calender, the year is divided in the following manner:

Thirty days hath September, April, June, and November;
February twenty eight alone, and all the reſt have thirty one.
When you can divide the year of our Lord by 4, without any remainder, it is then Biſſextile, or Leap Year, in which February has 29 days.

9. SOLID MEASURE.*

1728 Inches	make 1	Foot.
27 Feet		Yard.
40 Ft. of round tim. or 50 ft. of hewn tim.		Ton or Load.
128 Sol. Ft. i.e. 8 in len. 4 in brdth. & 4 in ht.		Cord of wood.

10. WINE MEASURE †

2 Pints	make 1	Quart. *Marked* pts	qts.
4 Quarts		Gallon.	gal.
10 Gallons		Anchor of brandy.	anc.
18 Gallons		Runlet.	run.
31½ Gallons		Half Hogshead.	½hhd.
42 Gallons		Tierce.	tier.
63 Gallons		Hogshead.	hhd.
2 Hogsheads		Pipe or Butt.	P. or B.
2 Pipes		Tun.	Tun.

11. ALE OR BEER MEASURE.‡

2 Pints	make 1	Quart. *Marked*	pts. qts.
4 Quarts		Gallon.	gal.
8 Gallons		Firk. of Ale in Lon.	A. fir.
8½ Gallons		Firkin of Ale or Beer.	
9 Gallons		Fir. of Beer in Lon.	B. fir.
2 Firkins		Kilderkin.	kil.
2 Kilderkins		Barrel.	bar.
1½ Bar. or 36 Gal.		Hogshead of Beer.	hhd.
2 Barrels		Puncheon	pun.
3 Bar. or 2 Hhd.		Butt.	butt.

12. DRY.

* By Solid Measure are measured all things that have length, breadth, and depth.

† All Brandies, Spirits, Perry, Cider, Mead, Vinegar, Honey, and Oil, are measured by Wine Measure; Honey is, commonly, sold by the pound Aviordupois.

‡ Milk is sold by the Beer quart.

5 ½ Gall.

12. DRY MEASURE.*

2	Pints	make 1	Quart. *Marked*	pts.
2	Quarts		Pottle.	pot.
2	Pottles		Gallon.	gal.
2	Gallons		Peck.	pk.
4	Pecks		Buſhel.	bu.
2	Buſhels		Strike.	ſtr.
2	Strikes		Coom.	co.
2	Cooms		Quarter.	qr.
2	Quarters		Chaldron.	ch.
4½	Quarters		Chaldron in London.	
5	Quarters		Wey.	wey.
2	Weys		Laſt.	laſt.

COMPOUND ADDITION

Is the adding of ſeveral numbers together, having different denominations, as Pounds, Shillings, Pence, &c. Tons, Hundreds, Quarters, &c.

RULE.

1. Place the numbers, ſo that thoſe of the ſame denomination may ſtand directly under each other.

2. Add the firſt column or denomination together as in whole numbers; then divide the ſum by as many of the ſame denomination as make one of the next greater, ſetting down the remainder under the column added, and carry the quotient to the next ſuperiour denomination, continuing the ſame to the laſt, which add as in ſimple addition.

1. MONEY.

* This meaſure is applied to all dry goods, as Corn, Seed, Fruits, Roots, Salt, Sand, Oyſters, and Coals.

A Wincheſter buſhel is 18½ inches diameter, and 8 inches deep.

1. MONEY.

Examples.

1.

£.	s.	d.
9	16	10
7	10	9
8	18	6
5	11	11

2.

£.	s.	d.	qr.
47	17	6	2
3	9	10	3
75	13	9	1
4	11	11	0

3.

£.	s.	d.	qr.
847	11	11	3
419	19	6	1
59	6	10	0
747	16	1	2

4.

£.	s.	d.	qr.
915	10	10	2
64	8	9	1
5	16	11	3
419	2	10	2

5.

£.	s.	d.	qr.
764	13	10	2
43	9	8	1
59	17	11	2
817	16	9	3

6.

£.	s.	d	qr.
584	19	10	3
765	14	8	1
91	17	10	2
18	19	6	3

French Money.

12 Deniers, or Pence } make 1 { Sol, or Shilling.
20 Sols or Shillings } make 1 { Livre, or Pound.
3 Livres, or Pounds } make 1 { Crown of exchange.
6 Livres, or Pounds } make 1 { Real Cro. or ecu d'argent.

Cr. exc.	liv.	fols.	den.
976	2	17	10
379	1	12	6
491	1	0	11
592	2	15	8

Ecu d'ar.	liv.	fols.	den.
567	5	13	11
389	1	19	6
548	4	17	10
632	3	11	9

Dutch Money.

8 Phennings } make 1 { Groat.
2 Groats, or 16 Phennings } make 1 { Stiver,
20 Stivers } make 1 { Guilder or Florin.

ALSO,

12 Groats, or 6 Stivers } make 1 { Schilling.
20 Schillings, or 6 Guilders } { Pound.

Guild.	stiv.	gr.	ph.	Guild.	stiv.	ph.	L.	sch.	gro.
167	17	1	7	549	19	14	357	18	11
348	12	0	6	347	21	12	508	12	6
491	13	1	3	859	13	8	497	13	10
749	19	1	4	467	10	15	618	17	8

2. TROY WEIGHT.

1. lb.	oz.	pwts.	2. lb.	oz.	pwts.	gr.	3. lb.	oz.	pwts.	gr.
767	10	17	649	11	19	20	859	9	15	20
39	6	9	32	9	6	5	437	10	17	22
417	11	16	841	10	11	19	641	11	6	0
935	9	17	473	9	17	23	738	9	12	18

3. AVOIRDUPOIS WEIGHT.

1. lb.	oz.	dr.	2. T.	Cwt.	qrs.	lb.	3. T.	Cwt.	qrs	lb.	oz.	dr.
19	13	12	59	13	2	17	91	17	2	25	13	15
21	9	6	6	17	1	21	19	9	0	17	10	12
4	15	15	45	11	3	25	14	13	2	0	9	11
22	10	5	57	16	2	19	47	11	3	19	14	0

4. APOTHECARIES' WEIGHT.

1. ℥	ʒ	℈	gr.	2. ℥	ʒ	℈	gr.	3. lb.	℥	ʒ	℈	gr.
9	1	1	17	10	7	3	19	12	11	6	1	15
3	2	1	19	6	3	0	12	4	9	1	0	12
6	1	1	17	7	6	1	17	19	10	2	2	16
4	0	1	6	9	5	2	12	4	8	1	2	19

5. CLOTH

5. CLOTH MEASURE.

1. Yd.	qr.	n.	2. E. E.	qr.	n.	3 E. Fl.	qr.	n.
70	2	3	91	3	2	914	2	3
3	3	1	49	4	3	49	2	1
42	3	3	6	2	3	561	3	0
57	2	2	84	4	1	84	0	2

6. LONG MEASURE.

1. Pol.	ft.	in.	2. Mil.	fur.	pol.	3. Deg.	mi	fur.	pol.	ft.	in.	hc.
52	11	10	9	7	36	759	56	6	29	15	10	2
9	16	9	7	3	19	317	39	1	36	11	6	1
8	12	11	4	1	24	497	63	7	24	9	8	1
7	15	6	6	5	12	562	17	0	11	13	11	0

7. TIME.

1. W.	d.	h.	m.	s.	2. Y.	mo.	d.	3. Y.	mo.	w.	d.	h.	m.	s.
3	6	22	57	42	19	10	19	57	11	3	6	23	29	55
1	5	19	31	28	7	9	27	4	8	1	1	19	45	38
2	3	17	9	15	4	8	16	29	9	2	3	17	18	19
3	0	9	17	58	1	11	14	46	10	2	5	11	50	13

8. LAND, or SQUARE MEASURE.

1. Pol	feet.	in.	2. Yds.	ft.	in.	3. Acres.	roo.	pol.	feet.	in.
36	179	137	28	7	119	756	3	37	245	128
19	248	119	9	3	75	29	1	28	93	25
12	96	75	29	6	120	416	2	31	128	119
18	110	122	4	8	12	37	1	19	218	20

9. SOLID

9. SOLID MEASURE.

1. Ton.	feet.	in.	2. Yds.	feet.	in.	3. Cord.	feet.	in.
29	36	1229	75	22	1412	37	119	1015
12	19	64	9	26	195	9	110	159
8	11	917	3	19	1091	48	127	1071
19	8	1001	28	15	1110	8	101	956

10. WINE MEASURE.

1. Tier.	gal	qts.	pts.	2. Hhd.	gal	qts.	pts.	3. Tun.	hhd.	gal.	qts.
37	39	3	1	51	53	1	1	37	2	37	2
9	17	2	1	27	39	3	0	19	1	59	1
4	28	0	0	9	18	0	1	28	2	0	0
32	19	1	1	0	9	2	1	19	0	47	1

11. ALE AND BEER MEASURE.

1. A.B.	ſr.	gal.	2. B.B.	ſr.	gal.	3. Hhd.	gal.	qts.
49	3	7	29	1	8	379	53	3
26	2	3	19	3	5	19	0	1
9	0	4	16	0	3	121	37	2
17	3	0	9	1	8	467	19	1

12. DRY MEASURE.

1 Qrs.	bu.	p.	qt.	2. Bu.	p.	qt.	pt.	3. Ch.	bu.	p.	qt.
64	7	3	7	37	2	5	1	37	27	3	5
9	4	1	5	19	3	7	0	6	29	1	7
19	6	2	1	16	2	0	1	15	30	0	0
4	0	2	0	5	1	6	1	4	11	3	0

COMPOUND SUBTRACTION

Teaches to find the difference, in equality, or excess, between any two sums of divers denominations.

RULE.

Place those numbers under each other, which are of the same denomination, the less being below the greater; begin with the least denomination, and, if it exceed the figure over it, borrow as many units as make one of the next greater; subtract it therefrom; and to the difference add the upper figure, remembering, always, to add one to the next superiour denomination, for that which you borrowed.

I. MONEY.

1.

	£.	s.	d.	qr.
Borrowed	349	15	6	1
Paid	195	11	8	1
Remains to pay	154	3	10	0
Proof				

2.

	£.	s.	d.	q.
Lent	791	9	8	1
Received	197	16	4	2
Due to me				

3.

	£.	s.	d.	q.
From	439	9	10	1
Take	196	0	10	3
Rem.				

4.

	£.	s.	d.	q.
	843	12	1	3
	746	15	0	2

5.

	£.	s.	d.	q.
	469	7	5	2
	508	16	4	0

6.

	£.	s.	d.
Borrowed	19372	12	6
Paid at sundry times	293	16	8
	74	9	7
	9413	11	0
	1994	0	10
	3914	19	0
	1064	17	9
Paid in all			
Rem. to be pd.			

7.

	£.	s.	d.	q.
Lent	27109	5	8	3
Rec. at several times	5196	15	10	0
	384	17	6	2
	4187	18	11	1
	1649	16	8	0
	917	9	16	3
	3196	0	2	3
Rec. in all				
Rem. due				

2. TROY WEIGHT.

	1. lb.	oz.	pwt	gr.	2. lb.	oz.	pwt.	gr.	3. lb.	oz.	pwt.	gr.
Bought	749	5	13	16	374	8	12	10	543	3	9	13
Sold	96	9	19	13	148	4	16	19	179	1	15	18
Rem.												

3. AVOIRDUPOIS WEIGHT.

	1. lb.	oz.	dr.	2. C.	qr.	lb.	3. T.	cwt.	qr.	lb.	oz.	dr.
Bought	7	9	12	8	2	13	9	11	3	17	5	12
Sold	3	12	9	4	1	15	3	12	2	19	10	9
Rem.												

4. APOTHECARIES'

4. APOTHECARIES' WEIGHT.

1. lb ℥ ʒ ℈ gr.	2. lb ℥ ʒ ℈ gr.	3. lb ℥ ʒ ℈ gr.
71 9 3 1 13	65 10 6 2 1	84 1 1 1 1
37 8 4 1 16	31 9 8 2 0	65 9 3 1 17

5. CLOTH MEASURE.

1. Yd. qr. n.	2. E.E. qr. n.	3. E.Fl. qr. n.	4. E.Fr. qr. n.
35 1 2	467 3 1	765 5 3	549 4 2
19 1 3	291 3 2	149 2 1	197 4 3

6. LONG MEASURE.

1. Yd. ft. in.	2. Mil. fur. pol.	3. Deg. m. fur. p. yd. ft in bar.
28 2 10	76 3 11	38 41 3 29 2 1 7 2
67 2 11	27 3 21	19 35 5 31 3 1 9 1

7. TIME.

1. Mon. d. h. m. s.	2. Y. mo. d.	3. Y. mo. wd. d. h. m. s.
6 17 13 27 19	7 3 13	48 9 2 5 19 27 31
1 21 16 41 35	4 2 19	19 9 3 4 20 19 49

8. LAND or SQUARE MEASURE.

1. A. R. Pol.	2. A. R. Pol.	3. A. R. Pol. ft. in.
29 1 10	29 2 17	56 2 16 27 110
24 1 25	17 1 36	29 0 21 210 129

9. SOLID

9. SOLID MEASURE.

1. T.	ft.	in.	2. Yds.	ft.	in.	3. Cords.	ft.	in.
49	19	1100	79	11	917	349	97	1250
38	36	1296	17	25	1095	192	127	1349

10. WINE MEASURE.

1. Tun.	gal.	qt.	pt.	2. Tier.	gal.	qt.	3. Tun.	hhd.	gal.
79	1	2	1	19	17	1	532	1	19
38	1	3	1	12	29	2	197	1	47

11. ALE AND BEER MEASURE.

A. B.	fir.	gal.	qt.	B. B.	fir.	gal.	qt.	pt.	Hhd.	gal.	qt.
39	1	2	1	21	3	5	2	0	769	1	1
24	3	6	2	19	1	7	2	1	391	42	3

12. DRY MEASURE.

1. Qu.	bu.	pk.	qt.	2. Bu.	pk.	qt.	qt.	3. Chal.	bu.	pk.	qt.
56	2	2	1	91	1	3	2	39	12	2	1
43	3	1	2	29	2	1	1	24	25	3	2

PROBLEMS

Reſulting from a Compariſon *of the preceding Rules.*

PROB. 1. Having the ſum of two numbers, and one of them given to find the other.

Rule. Subtract the given number from the given ſum, and the remainder will be the number required.

Let

Here 288 be the sum of two numbers, one of which is 115, the other is required.

From 288 the sum,
Take 115 the given number.

Rem. 173 the other.

Prob. 2. Having the greater of two numbers, and the difference between that and the less, given, to find the less.

Rule. Subtract the one from the other.

Let the greater number be 325, and the difference between that and the other, 198: What is the other?

From 325 the greater,
Take 198 the difference.

Rem. 127 the less.

Prob. 3. Having the least of two numbers given, and the difference between that and a greater, to find the greater.

Rule. Add them together.

Given { 127 the less number,
198 the difference.

Sum 325 the greater number required.

Prob. 4. Having the sum and difference of two numbers given, to find those numbers.

Rule. To half the sum add half the difference, and the sum is the greater; and from half the sum take half the difference, and the remainder is the less.—Or, from the sum take the difference, and half the remainder is the least: To the least add the given difference, and the sum is the greatest.

What are those two numbers, whose sum is 48, and difference 14?

2)48 2)14

½ sum=24 ½ diff.=7

24+7=31 the greater; and 24−7=17 the less.

Or, 48−14÷2=17; and 17+14=31.

Prob.

PROB. 5. Having the ſum of two numbers, and the difference of their ſquares given, to find thoſe numbers.

Rule. Divide the difference of their ſquares by the ſum of the numbers, and the quotient will be their difference: You will then have their ſum and difference, to find the numbers by Prob. 4.

What two numbers are thoſe, whoſe ſum is 32, and the difference of whoſe ſquares is 256?

32)256(8 difference.
256

Half ſum	16
Half diff.	4
Greater	20
Leſs	12

PROB. 6. Having the difference of two numbers, and the difference of their ſquares given, to find thoſe numbers.

Rule. Divide the difference of their ſquares by the difference of the numbers, and the quotient will be their ſum; then proceed by Prob. 4.

What are thoſe two numbers, whoſe difference is 20, and the difference of whoſe ſquares is 2000?

20)2000(100 ſum. 50+10=60, the greater; and 50—10=40, the leſs.

PROB. 7. Having the product of two numbers, and one of them given, to find the other.

Rule. Divide the product by the given number, and the quotient will be the number required.

Let

Let the product of two numbers be 288, and one of them 8; I demand the other?

8)288
Anſ. 36

PROB. 8. Having the dividend and quotient, to find the diviſor.

Rule. Divide the dividend by the quotient.

COR. Hence we get another method of proving Diviſion.

Given { 288 the dividend. / 36 the quotient.
Required the diviſor.

36)288(8 diviſor.
288
—

PROB. 9. Having the diviſor and quotient given, to find the dividend.

Rule. Multiply them together.

Given { 8 the diviſor. / 36 the quotient.
Required the dividend.

36
8
—
288 the dividend.

By a due conſideration and application of theſe Problems only, many queſtions may be reſolved in a ſhort and elegant manner, although ſome of them are generally ſuppoſed to belong to higher rules.

APPLICATION OF THE PRECEDING RULES.

1. The leaſt of two numbers is 19418, and the difference between them is 238: What is the greater, and ſum of both?

19418+2384=21802, greater; and 19418+21802 =41220, ſum.

2. Suppoſe a man born in the year 1743: When will he be 57 years of age?

1743+57=1800, *Anſ.*

3. What

3. What number is that, which being added to 19418, will make 21802?

21802—19418=2384. *Anſ.*

4. General Waſhington was born in 1732: What was his age in 1787? 1787—1732=55. *Anſ.*

5. America was diſcovered by Columbus in 1492, and its Independence declared in 1776: How many years have elapſed between thoſe two æras?

1776—1492=284, *Anſ.*

6. The Maſſacre at Boſton, by the Britiſh Troops, happened, March 5th, 1770, and the Battle of Lexington, April 19th, 1775: How long between?

April 19, 1775—March 5, 1770=5y. 1m. 14d. *Anſ.*

7. General Burgoyne and his army were captured October 17th, 1777, and Earl Cornwallis and his army, October 19th, 1781: What ſpace of time between?

October 19, 1781—October 17, 1777=4 years and 2 days, *Anſ.*

8. The war between America and England commenced April 19th, 1775, and a general peace took place January 20th, 1783: How long did the war continue?

Jan. 20, 1783—April 19, 1775=7y. 9m. 1d. *Anſ.*

9. A, B, C, and D, purchaſed a quantity of goods in partnerſhip; A paid £12 10s. a dollar, and a crown piece; B, 35s; C, 29s. 10d.; and D, 79d.: What did the goods coſt? *Anſ.* £16 14s. 1d.

10. A man borrowed, at different times, theſe ſeveral ſums, viz. £29 5s. £18 17s. 6d. £45 12s. £98, 3 dollars, one crown piece and a half: Pray how much was he in debt? *Anſ.* £193 2s. 6d.

11. There

11. There are 4 numbers; the firſt 317, the ſecond 912, the third 1229, and the fourth as much as the other three, abating 97: What is the ſum of them all?

Anſ. 4819.

12. Bought a quantity of Goods for £125 10*s.* paid for truckage 45*s.* for freight 79*s.* 6*d.* for duties 35*s.* 10*d.* and my expenſes were 53*s.* 9*d*: What did the Goods ſtand me in? *Anſ.* £136 4*s.* 1*d.*

13. A Gentleman left his ſon £1725 more than his daughter, whoſe fortune was 15 thouſand 15 hundred and 15 pounds: What was the ſon's portion, and what did the whole eſtate amount to?

Anſ. The ſon's fortune, £18240, and the whole eſtate £34755.

14. A merchant had 6 debtors, who, together, owed him £4917 10*s.* 6*d.* A, B, C, D, and E, owed him £1675 13*s.* 9*d.* of it: what was F's debt?

Anſ. £3241 16*s.* 9*d.*

15. What is the difference between £1309 7*s.* 1*d.* and the amount of £345 13*s.* 4*d.* and £571 4*s.* 8*d.*?

Anſ. £392 9*s.* 1*d.*

16. A Merchant, at his firſt engaging in trade, owed £937 15*s.* he had in caſh £1755 3*s.* 6*d.* in goods £459 12*s.* 3*d.* in good debts £197 16*s.* and he cleared the firſt year £249 19*s.* 10*d.* What was the neat balance at the year's end? *Anſ.* £1724 16*s.* 7*d.*

17. What ſum of money muſt be divided between 12 men, ſo as that each may receive £155?

£155×12=£1860 *Anſ.*

18. What number muſt I multiply by 9, that the product may be 675? 675÷9=75 *Anſ.*

19. A Privateer of 175 men took a prize, which amounted to £59 per man, beſides the owner's half: What was the value of the prize? 165×59×2=£20650 *Anſ.*

20. What is the difference between thrice five, and thirty; and thrice thirty five?

$35\times3-5\times3+30=60$, *Anſ.*

21. The ſum of two numbers is 750; the leſs 248: What is the difference, product, and the ſquare of their difference?*

$750-248=502$ the greater number, $502-248=254$ difference, $502\times248=124496$ product, and $254\times254=64516$ ſquare of the difference.

22. What is the difference between ſix dozen dozen and half a dozen dozen; and what is their product, and the quotient of the greater by the leſs?

Anſ. $6\times12\times12-6\times12=792$ diff. $6\times12\times12\times6\times12=62208$ product, and $6\times12\times12\div6\times12=12$, Quotient.

23. There are two numbers; the greater of them is 25 times 78, and their difference is 9 times 15; their ſum and product are required.

Anſ. $78\times25=1950$ the greater, $1950-15\times9=1815$ the leſs. $1950+1815=3765$ the ſum, and $1950\times1815=3539250$ the product.

24. A Merchant began trade with £25327; for 6 years together, he cleared £1253 *per annum*; the next 5 years, he cleared £1729 *per annum*; but, the laſt 4 years, had the misfortune to loſe £3019 *per annum*: What was he worth at the 15 years' end?

Anſ. £29414.

25. If a man ſpends £192 in a year: What is that per calendar month? $192\div12=£16$ *Anſ.*

26. If

* A number is ſaid to be ſquared, when it is multiplied into itſelf.

26. If the Federal Debt which is 42 million dollars, be equally divided between the 13 States; what will be the ſhare of each? *Anſ.* 3230769 $\frac{3}{13}$ dollars.

27. If 9000 men march in a column of 750 deep: How many march abreaſt? 9000÷750=12 *Anſ.*

28. What number, deducted from the 32d part of 3072, will leave the 96th part of the ſame?

3072÷32—32=64 *Anſ.*

29. What number is that, which, multipled by 3589, will produce 92050672?

92050672÷3589=25648 *Anſ.*

30. Suppoſe the quotient ariſing from the diviſion of two numbers to be 5379, the diviſor 37625: What is the dividend if the remainder come out 9357?

37625×5379+9357=202394232 *Anſ.*

REDUCTION.

Teaches to bring, or exchange, numbers of one denomination to others of different denominations, retaining the ſame value.

It is of *two* ſorts, viz. Deſcending and Aſcending; the former of which is performed by Multiplication, and the latter by Diviſion.

Reduction Descending.

Rule.

Multiply the higheſt denomination, given, by ſo many of the next leſs, as make one of that greater, and thus continue till you have brought it down as low as your queſtion requires.

Proof. Change the order of the queſtion and divide your laſt product by the laſt multiplier, and ſo on.

Examples.

Examples.

1. In £27 15*s.* 9*d.* 2*qr.* how many farthings?

£	*s.*	*d.*	*qr.*
27	15	9	2

Multiplied by 20 = Shillings in a pound.

555 = Shillings.
——— by 12 = Pence in a Shilling.

6669 = Pence.
——— by 4 = Farthings in a Penny.

Anſ. = 26678 Farthings.

Note. In multiplying by 20, I added in the 15*s.*—by 12, the 9*d.* and by 4, the 2*qrs.* which muſt always be done in like caſes.

To prove the above queſtion, change the order of it and it will ſtand thus: In 26678 farthings how many pounds?

4)26678

12)6669 2 *qrs.*

20)555 9*d.*

Anſ. £27 15 9 2.

2. In £36 12*s.* 10*d.* 1*qr.* how many farthings?
Anſ. 35177.

3. In £95 11*s.* 5*d.* 3*qrs.* how many farthings?
Anſ. 91751.

4. In £719 9*s.* 11*d.* how many half pence?
Anſ. 345358.

5. In 29 guineas, at 28*s.* how many pence?
Anſ. 9744.

6. In

6. In 37 piſtoles at 22s. how many ſhillings, pence and farthings ?

Anſ. 814s. 9768d. 39072 farthings.

7. In 49 half johannes, at 48s. how many ſixpences ?

Anſ. 4704

8. In 473 French crowns. at 6s. 8d. how many threepences ? *Anſ.* 12613⅓.

9. In 53 moidores, at 36s. how many ſhillings, pence and farthings ?

Anſ. 1908s. 22896d. 91584qrs.

10. In £29 how many groats, threepences, pence and farthings ?

Anſ. 1740 groats, 2320 threepences, 6960d. 27840qrs.

11. Reduce 47 guineas and one fourth of a guinea into ſhillings, ſixpences, groats, threepences, twopences, pence and farthings.

Anſ. 1323 ſhillings, 2646 ſixpences, 3969 groats, 5292 threepences, 7938 twopences, 15876 pence, and 63504 farthings.

REDUCTION ASCENDING.

RULE.

Divide the loweſt denomination given, by ſo many of that name, as make one of the next higher, and thus continue, till you have brought it into that denomination which your queſtion requires.

EXAMPLES.

1. In 547325 farthings how many pence, ſhillings and pounds ?

Farthings in a penny = 4)547325

Pence in a ſhilling = 12)136831 1qr.

Shillings in a pound = 2|0)1140|2 7d.

£570 2s. 7d. 1qr.

Anſ. 136831d. 11402s. and £57[illegible]

Note. The remainder is always of the ſame name as the dividend.

2. Bring 35177 farthings into pounds.

3. Bring 91751 farthings into pence, &c.

4. Bring 345358 half pence into pence, ſhillings and pounds.

5. Reduce 9744 pence into guineas, at 28s. per guinea.

6. In 39072 farthings, how many piſtoles, at 22s.?

7. In 4704 ſixpences, how many half johannes?

8. In 12613$\frac{2}{3}$ threepences, how many French crowns at 6s. 5d.?

9. In 91584 farthings, how many moidores, at 36s.?

10. In 27840 farthings, how many pence, threepences, groats, ſhillings and pounds?

11. In 63504 farthings, how many pence, twopences, threepences, groats, ſixpences ſhillings and guineas?

Note. The preceding queſtions may ſerve as proofs to thoſe in Reduction deſcending.

REDUCTION DESCENDING AND ASCENDING.

1. Money.

1. In £97 how many pence, and Engliſh or French crowns, at 6s. 8d.?

Anſ. 23280d. and 291 crowns.

2. In 947 Engliſh crowns, at 6s. 8d. how many ſhillings, and Engliſh guineas?

Anſ. 6313s. 4d. and 225 guin. 13s. 4d.

3. In

3. In 519 Engliſh half crowns, how many pence and pounds? *Anſ.* 2076od. and £86 10s.

4. In 1259 groats, how many farthings, pence, ſhillings and guineas?

Anſ. 20144qrs 5036d. 419s. 8d. and 14 guineas, 27s. 8d.

5. In 75 piſtoles, how many pounds?

Anſ. £82 10s.

6. In 735 French crowns, how many ſhillings and French guineas, at 26s. 8d.?

Anſ. 4900s. and 183 guineas, 20s.

7. In 5793 pence, how many farthings, pounds and piſtoles?

Anſ. 23172qrs. £24 2s. 9d. and 21 piſtoles, 20s. 9d.

8. In £99 how many ſhillings, and half johannes, at 48s.? *Anſ.* 1980s. and 41 half joes, 12s.

9. In £179 how many guineas?

Anſ. 127 guineas, 24s.

10. In £345 how many moidores?

Anſ. 191 moidores, 24s.

11. In 59 half joes, 37 moidores, 45 guineas, 63 piſtoles, 24 Engliſh crowns, and 19 dollars; how many pounds, half joes, moidores, guineas, piſtoles, Engliſh crowns, dollars, ſhillings, pence, and farthings

Anſ. £354 4s. 147 half joes, 28s. 196 moidores, 28s. 253 guineas, 322 piſtoles, 1062 Engliſh crowns, 4s. 1180 dollars, 4s. 7084 ſhillings, 8500d. and 340032qrs.

When it is required to know how many ſorts of coin, of different values, and of equal number, are contained in any number of another kind; reduce the ſeveral ſorts of coin into the loweſt denomination mentioned, and add them together for a diviſor; then, reduce the money given into the ſame denomination for a dividend, and th

quotient

quotient arising from the diviſion, will be the number required.

Note. Obſerve the ſame direction in weights and meaſures.

1. In 275 half Johannes, how many moidores, guineas, piſtoles, dollars, ſhillings and ſix pences, of each the like number?

A moid. is 36s. } 72 ſixpences. 275 half joes.
that is } 48s. in a johan.

A guin. is 28s. } 56 ditto 2200
that is } 1100

A piſtole is 22s. } 44 ditto 13200 ſhillings.
that is } 2 ſixp. in a ſhill.

A dollar is 6s. } 12 do. Div=26400 ſixpences.
that is }
One ſhilling has 2
1

Diviſor=187 ſixpences.

187)264200(141 of each and 33 ſixpences, or 16s. 6d. over the *Anſ.*

2. A gentleman diſtributed £37 10s. between 4 perſons in the following manner, viz. that as often as the firſt had 20s. the ſecond ſhould have 15s. the third 10s. and the fourth, 5s. What did each perſon receive?

Anſ. the firſt man £15.

2. TROY

2. Troy Weight.

1. How many grains in a silver bowl, that weighs 3lb. 10oz. 12*pwt.* ?

lb. *oz.* *pwt.*
3 10 12
12 ounces in a pound.

46 ounces.
20 pennyweights in one ounce.

932 pennyweights.
24 grains in one pwt.

3728
1864

Proof. 24)22368 grains, *Answer.*

2|0)93|2
12)46—12 pwt.

lb. 3—10oz.

2. In 487 *ozs.* how many *pwts.* and *grs.* ?
Anf. 9740*pwts.* 233760*grs.*

3. In 13 ingots of gold each weighing 90*z.* 5*pwt.* how many grains ? *Anf.* 57720*gr.*

4. In 97397 *grs.* how many pounds ?
Anf. 16lb. 10oz. 17*pwt.* 5*gr.*

5. How many rings, each weighing 5*pwt.* 7*gr.* may be made of 3lb. 5*oz.* 16*pwt.* 2*gr.* of gold ?
Anf. 158.

3. Avoirdupois.

3. Avoirdupois.

1. In 91 Cwt. 3 qr. 17 lb. 14 oz. how many ounces?

4

367 quarters.
28

2943
735

10293 pounds.
16

61762
10293

164792 ounces.

Proof.

16)164702

28)10293 14oz.

367 17lb.

Cwt. 91 3 qrs.

2. In 12 tons, 15 cwt. 1qr. 19lb. 6oz. 12dr. how many drams?

Anſ. 7385c0dr.

3. In 24lb. 11oz. 9dr. how many drams?

Anſ. 6329dr.

4. In 44800 pounds, how many drams and tons?

Anſ. 11468800dr. and 20 tons.

5. In

5. In 28lb. Avoirdupois, how many pounds Troy?

lb.
28
7000 grains, in 1lb. Avoirdupois.

grs. in 1lb. *tr.* } = 5760)196000(34lb.

1728

2320
2304

160
12

5760)1920(0oz.
20

5760)3840(6*pwt.*
3456

3840
24

5760)9216(16*gr.*
576

3456
3456

6. In 47lb. 9*oz.* 13*pwt.* 17*grs.* Troy, how many lb. Avoirdupois?

lb.	*oz.*	*pwt.*	*gr.*
47	9	13	17
12			
572			
20			
11473			
24			
45899			
22947			

7000)275369(39lb.
21

65
63

2369
16

14214
2369

7000(37904(5oz.

Carried over

Brought over 7|000)37|904(5*oz.*
35

2904
16

17424
2904

7|000)46|464(1$\frac{4464}{7000}$*dr.*
42

4464

4. Apothecaries' Weight.

1. How many grains are there in 37lb. 6ʒ ?

lb.	*oz.*
37	6
	12
450	*ounces.*
	8
3600	*drams.*
	3
10800	*scruples.*
	20
216000	*grains.*

Proof.
2|0)216000
3)10800
8)3600
12)450
37lb 6ʒ

2. In 9lb 8ʒ 1ʒ 2℈ 19*gr.* how many grains ?
Anſ. 55799*gr.*

3. In 55799 grains how many pounds, &c.
Anſ. 9lb. 8ʒ 1ʒ 2℈ 19*gr.*

5. Cloth

5. Cloth Measure.

1. In 127 yards, how many quarters and nails?

Yds.	Proof.
127	
4	4)2032
508 qrs.	
4	4)508
Anſ. 2032 nails.	127 yards.

2. In 9173 nails how many yards?
Anſ. 573yds. 1qr. 1n.

3. In 75 ells Engliſh, how many quarters and nails?
Anſ. 375qrs. 1500n.

5. In 56 ells Flemiſh, how many quarters and nails?
Anſ. 168qrs. 672n.

5. In 39 ells French, how many quarters and nails?
Anſ. 234qrs. 936n.

6. In 7248 nails how many yards, ells Flemiſh, ells Engliſh and ells French?
Anſ 453yds. 604 ells Flem. 362 ells Eng. 2qrs. 302 ells French.

7. In 19 pieces of cloth, each 15 yards 2 quarters, how many yards, quarters and nails?
Anſ. 294yds. 2qrs. 1178qrs. & 4712n.

6. Long

6. Long Measure.

1. How many barley corns will reach from Newburyport to Boſton, it being 43 miles?

Miles.

43
8

344 furlongs.
40

13760 rods.
$5\frac{1}{2}$

68800
6880

75680 yds.
3

227040 feet.
12

2724480 inches.
3

8173440 *Anſ.*

Proof.

3)8173440

12)2724480

3)227040

11)75680

6830
2

4|0)13760

8)344

43

Here I divide by 11, and multiply the quotient by 2, becauſe twice $5\frac{1}{2}$ is 11,—or I might firſt have multiplied by 2, and then, have divided the product by 11.

2. How many barley corns will reach round the globe, it being 360 degrees? *Anſ* 475580160o.

3. How many inches from Newburyport to London, it being 2700 miles? *Anſ.* 1710[illegible]2000.

4. [illegible]ow

4. How often will a wheel, of 16 feet and 6 inches circumference, turn round in the diſtance from Newburyport to Cambridge, it being 42 miles?

Anſ. 13440 times.

5. In 190080 inches how many yards and leagues?

Anſ. 5280yds. and 1 league.

7. TIME.

1. In 24 years how many ſeconds?

d. h.
365 6 in a year.
24
1466
730
8766 hours in one year.
20
175320 hours in 20 years,
60
10519200 minutes in ditto.
60
631152000 ſeconds in ditto.

Proof.
6|0)631152000
6|0)10519200
2|0)17532|0
4×6)8766
4)1461
365d. 6h.

2. Suppoſe your age to be 15y. 19d. 11h. 37m. 45s. how many ſeconds are there in it, allowing 365 days and 6 hours to the year? *Anſ.* 475047465.

3. How many minutes from the firſt day of January to the 14th day of Auguſt, incluſively?

Anſ. 325440.

4. How many days ſince the commencement of the Chriſtian Æra?

5. How

5. How many minutes since the commencement of the American war, which happened on the 19th day of April, 1775?

6. How many seconds between the commencement of the war, April 19th, 1775, and the independence of the United States of America which took place the 4th day of July, 1776? *Anſ.* 38102400.

8. Land or Square Measure.

1. In 29 acres, 3 roods, 19 poles, how many roods and perches?

Acr. r. p.	Proof.
29 3 19	4)47719
4	4)119—19p.
119 roods.	29ac—3r.
40	

Anſ. 4779 perches.

2. In 1997 poles, how many acres?

Anſ. 12a. 1r. 37p.

9. Solid Measure.

1. In 15 tons of hewn timber, how many ſolid inches?

15 tons.	Proof.
50	5lo
750 feet.	1728)1296000(75lo
1728	12096
6000	15 Tons.
1500	8640
5250	8640
750	

Anſ. 1296000 inches.

2. In

9. In 9 tons of round timber, how many inches ?
Anſ. 622080.

10. Wine Measure.

In 9hhds. 15gal. 3qts. of wine how many quarts ?

hhds.	gal.	qts.
9	15	3
63		
32		
55		
582 gallons.		
4		

Proof.

4)2331

63)582—qts.

9 hhds.—15.

Anſ. 2331 quarts.

2. In 12 pipes of wine how many pints ?
Anſ. 12096.

3. In 9758 pints of brandy how many pipes ?
Anſ. 9p. 1hhd 22gal. 3qts.

4. In 1008 quarts of cyder, how many tuns ?
Anſ. 1 tun.

11. Ale *or* Beer Measure.

1. In 29hhds. of beer how many pints ?

hhds.	
29	
54	
116	
145	
1566 gallons.	
4	
6264 quarts.	
2	

Proof.

2)12528

4)6264

54)1566

29hhd.

Anſ. 12528 pints.

2. In

2. In 47bar 18gal. of ale, how many pints? *13680*
Anſ. [illegible]

3. In 36 puncheons of beer how many butts?
Anſ. 24.

12. Dry Measure.

1. In 42 chaldrons of coals how many pecks?

Chaldrons.	Proof.
42	4)5376
32	32)1344(42
84	128
126	64
1344 buſhels.	64
4	

Anſ. 5376 pecks.

2. In 75 buſhels of corn, how many pints?
Anſ. 4800.

3. In 9376 quarts, how many buſhels?
Anſ. 293.

VULGAR FRACTIONS.

Fractions, or broken numbers, are expreſſions for any aſſignable parts of a unit, or whole number; and are repreſented by two numbers, placed one above another, with a line drawn between them, thus, $\frac{5}{8}$, $\frac{4}{3}$, &c. ſignifying five eighths, four thirds, that is, one and one third, &c.

The figure above the line, is called the numerator and that below it the denominator.

The denominator (which is the diviſor in diviſion) ſhows how many parts the integer is divided into; and the numerator (which is the remainder after diviſion) ſhows

shows how many of those parts are meant by the fraction.

Fractions are either proper, improper, single, compound, or mixed. Any whole number may be made an improper fraction, by drawing a line under it, and putting unity, or 1, for a denominator, as 9 may be expressed fractionwise, thus, $\frac{9}{1}$, and 12 thus, $\frac{12}{1}$, &c.

1. A *single, simple,* or *proper fraction* is, when the numerator is less than the denominator, as $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{19}{31}$, &c. and is a simple expression for any number of parts of the integer.

2. An *improper fraction* is, when the numerator exceeds the denominator, as $\frac{5}{3}$, $\frac{8}{3}$, $\frac{14}{4}$, &c.

3. A *compound fraction* is the fraction of a fraction, coupled by the word *of*, thus, $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$, &c. which are read thus, two thirds of three fourths; one half of three fifths of seven eighths.

4. A *mixed number* is composed of a whole number and a fraction, as $7\frac{3}{13}$, $35\frac{4}{13}$, &c. that is, seven and three fifths, &c.

5. A fraction is said to be in its least, or lowest terms, when it is expressed by the least numbers possible.

6. The *common measure* of two, or more, numbers, is that number which will divide each of them, without a remainder: Thus, 5 is the common measure of 10, 20 and 30; and the greatest number, which will do this, is called the greatest common measure.

7. A number which can be measured by two, or more numbers, is called their common multiple; and if it be the least number, which can be so measured, it is called the least common multiple; thus, 40, 60, 80, 100 are multiples of 4 and 5; but their least common multiple is 20.

8.

8. A *prime number* is that which can only be measured by itself, or a unit.

9. That number which is produced by multiplying several numbers together is called a compoſite number.

10. A *perfect number* is equal to the ſum of all its aliquot parts.

PROBLEM I.

To find the greateſt common meaſure of two or more numbers.

RULE.

1. If there be two numbers only, divide the greater by the leſs, and this diviſor by the remainder, and ſo on, always dividing the laſt diviſor by the laſt remainder, till nothing remain, then will the laſt diviſor be the greateſt common meaſure required.

2. When there are more than two numbers, find the greateſt common meaſure of two of them, as before; then of that common meaſure and one of the other numbers, and ſo on, through all the numbers to the laſt; then will the greateſt common meaſure, laſt found, be the anſwer.

3. If 1 happens to be the common meaſure, the given numbers are prime to each other, and found to be incommenſurable, or in their loweſt terms.

EXAMPLES.

Examples.

1. What is the greateſt common meaſure of 1836, 3996, and 1044?

1836)3996(2
3672
324)1836(5
1620
216)324(1
216
Com. meaſ. = 108)216(2
216

So 108 is the greateſt common meaſure of 3996 and 1836;
Hence 108)1044(9
972
72)108(1
72
Laſt gr. com. meaſ. = 36)72(2
72

Therefore, 36 is the anſwer required.

2. What is the greateſt common meaſure of 1224 and 1080? *Anſ.* 72.

Problem II.

To find the leaſt common multiple of two, or more, numbers.

Rule.

1. Divide by any number, that will divide two or more of the given numbers, without a remainder, and ſet the quotients, together with the undivided numbers, in a line beneath.

2. Divide the ſecond line, as before, and ſo on, till there are no two numbers that can be divided; then, the continued product of the diviſors and quotients, will give the multiple required.

Examples.

Examples.

1. What is the leaſt common multiple of 6, 10, 16, and 20?

*5)6	10	16	20
*2)6	2	16	4
*2)3	1	8	2
*3	1	*4	1

* * * *

$5\times2\times2\times3\times4=240$ *Anſ.*

I ſurvey my given numbers and find that five will divide two of them, viz. 10 and 20, which I divide by 5, bringing, into a line with the quotients, the numbers, which 5 will not meaſure: Again, I view the numbers in the ſecond line, and find 2 will meaſure them all, and I get 3, 1, 8, 2, in the third line, and find that 2 will meaſure 8 and 2, and in the fourth line, get 3, 1, 4, 1, all prime, I then multiply the prime numbers and the diviſors continually into each other, for the number ſought, and find it to be 240.

2. What is the leaſt common multiple of 6 and 8? *Anſ.* 24.

3. What is the leaſt number that 3, 5, 8 and 10 will meaſure? *Anſ.* 120.

4. What is the leaſt number which can be divided by the 9 digits ſeparately, without a remainder? *Anſ.* 2520.

REDUCTION OF VULGAR FRACTIONS

Is the bringing of them out of one form into another, in order to prepare them for the operations of Addition, Subtraction, &c.

CASE

CASE I.*

To abbreviate, or reduce Fractions to their loweſt terms.

RULE.

Divide the terms of the given fraction by any number, which will divide them without a remainder. and the quotients, again, in the ſame manner; and ſo on, till it appears that there is no number greater than 1, which

* That dividing both the terms, that is, both numerator and denominator of the fraction, equally by any number, whatever, will give another fraction, equal to the former, is evident: And if thoſe diviſions be performed as often as can be done, or the common diviſor be the greateſt poſſible, the terms of the reſulting fraction muſt be the leaſt poſſible.

NOTE 1. Any number, ending with an even number or cypher, is diviſible by 2.

2. Any number, ending with 5 or 0, is diviſible by 5.

3. If the right hand place of any number be 0, the whole is diviſible by 10.

4. If the two right hand figures of any number be diviſible by 4, the whole is diviſible by 4.

5. If the three right hand figures of any number be diviſible by 8, the whole is diviſible by 8.

6. If the ſum of the digits, conſtituting any number, be diviſible by 3 or 9, the whole is diviſible by 3 or 9

7. If a number cannot be divided by ſome number leſs than the ſquare root thereof, that number is a prime.

8. All prime numbers, except 2 and 5, have 1, 3, 7, or 9 in the place of units; and all other numbers are compoſite.

9. When numbers with the ſign of Addition or Subtraction between them, are to be divided by any number, each of the numbers muſt be divided: Thus. $\frac{6+9+12}{3}=2+3+4=9$.

10. But if the numbers have the ſign of Multiplication between them; then only one of them muſt be divided: Thus, $\frac{4\times6\times10}{2\times5}=\frac{2\times6\times10}{1\times5}=\frac{2\times6\times2}{1\times1}=\frac{24}{1}=24$.

which will divide them, and the fraction will be in its loweſt terms. *Or*,

Divide both the terms of the fraction by the greateſt common meaſure, and the quotients will be the terms o the fraction.

EXAMPLES.

1. Reduce $\frac{288}{480}$ to its loweſt terms.

$\left.\begin{array}{l}\text{2}\\ \text{3}\end{array}\right\}$ $\frac{288}{480}=\frac{(4)\ 36}{(3)\ 60}=\frac{9}{15}=\frac{3}{5}$ *the anſwer.*

Or thus:

288)480(1 Therefore 96 is the greateſt common
288 meaſure.

192)288(1 and 96 $\left\}\right.$ $\frac{288}{480}=\frac{3}{5}$ the ſame as before.
192

Com. meaſ. 96)192(2

2. Reduce $\frac{57}{450}$ to its loweſt terms. *Anſ.* $\frac{19}{150}$.
3. Reduce $\frac{46}{184}$ to its loweſt terms. *Anſ.* $\frac{1}{4}$.
4. Reduce $\frac{1429}{2871}$ to its loweſt terms. *Anſ.* $\frac{1}{2}$.

CASE II.

To reduce a mixed number to its equivalent improper Fraction.

RULE.*

Multiply the whole number by the denominator of the fraction, and add the numerator of the fraction to the product; under which ſubjoin the denominator, and it will form the fraction required.

EXAMPLES.

* All fractions repreſent a diviſion of a numerator by the denominator, and are taken altogether as proper and adequate expreſſions of the quotient. Thus the quotient of 3, divided by 4 is $\frac{3}{4}$.

EXAMPLES.

1. Reduce $36\frac{5}{8}$ to its equivalent improper fraction.

36
8
+5
—
Anſ. 293
—
8
—

I multiply 36 by 8, and adding the numerator 5 to the product, as I multiply, the ſum, 293 is the numerator of the fraction ſought, and 8 the denominator: So that $\frac{293}{8}$ is the improper fraction, equal to $36\frac{5}{8}$.

Or, $\frac{36\times8+5}{8}=\frac{293}{8}$ *Anſwer* as before.

2. Reduce $127\frac{4}{7}$ to its equivalent improper fraction. *Anſ.* $\frac{2163}{17}$.

3. Reduce $653\frac{3}{19}$ to its equivalent improper fraction. *Anſ.* $\frac{12410}{19}$.

CASE III.

To reduce a whole number to an equivalent fraction, having a given denominator.

RULE.

Multiply the whole number by the given denominator: Place the product over the ſaid denominator, and it will form the fraction required.

EXAMPLES.

1. Reduce 6 to a fraction, whoſe denominator ſhall be 8.

$6\times8=48$, and $\frac{48}{8}$ the *Anſ.*—Proof $\frac{48}{8}=48\div8=6$.

2. Reduce 15 to a fraction, whose denominator shall be 12. *Anſ.* $\frac{180}{12}$.

CASE IV.

To reduce an improper fraction to its equivalent whole, or mixed number.

RULE.*

Divide the numerator by the denominator; the quotient will be the whole number, and the remainder, if any, will be the numerator to the given denominator.

EXAMPLES.

1. Reduce $\frac{293}{8}$ to its equivalent whole, or mixed number.

8)293(36$\frac{5}{8}$ *Anſ.*
24
—
53
48
—
5

Or, $\frac{293}{8}=293\div 8=36\frac{5}{8}$ as before.

2. Reduce $\frac{2163}{17}$ to its equivalent whole, or mixed number. *Anſ.* $127\frac{4}{17}$.

3. Reduce $\frac{45}{5}$ to its equivalent whole number. *Anſ.* 9.

CASE V.

To reduce a compound fraction to an equivalent ſimple one.

RULE.

Multiply all the numerators continually together for a new numerator, and all the denominators, for a new

* This rule is evidently the reverſe of Caſe 2d.

new denominator, and they will form the ſimple fraction required.

If part of the compound fraction be a whole or mixed number, it muſt be reduced to an improper fraction, by caſe 2d, or 3d.

If the denominator of any member of a compound fraction be equal to the numerator of another member thereof, theſe equal numerators and denominators may be expunged, and the other members continually multiplied, (as by the rule) will produce the fractions required in lower terms.

Examples.

1. Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ to a ſimple fraction.

$$\frac{1\times2\times3\times4}{2\times3\times4\times5}=\frac{24}{120}=\frac{1}{5}$$ the *Anſ.*

Or, by expunging the equal numerators and denominators, it will give $\frac{1}{5}$ as before.

2. Reduce $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{11}{12}$ to a ſimple fraction.

$\frac{3\times4\times5\times11}{4\times5\times6\times12}=\frac{660}{1440}=\frac{11}{24}$ *Anſ.* Or by expunging the equal numerators and denominators, it will be $\frac{3\times11}{6\times12}=\frac{33}{72}=\frac{11}{24}$ as before.

CASE VI.

To reduce fractions of different denominators, to equivalent fractions, having a common denominator.

Rule I.

Multiply each numerator into all the denominators, except its own, for a new numerator, and all the denominators

nators into each other continually, for a common denominator.

Examples.

1. Reduce $\frac{1}{4}$, $\frac{2}{5}$ and $\frac{4}{8}$ to equivalent fractions, having a common denominator.

$1 \times 5 \times 8 = 40$ the new numerator for $\frac{1}{4}$
$2 \times 4 \times 8 = 64$ ditto for $\frac{2}{5}$.
$5 \times 4 \times 5 = 100$ ditto for $\frac{4}{8}$.
$4 \times 5 \times 8 = 160$ the common denominator.

Therefore the new equivalent fractions are $\frac{40}{160}$, $\frac{64}{160}$, and $\frac{100}{160}$. the *Anſ.*

2. Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$ and $\frac{7}{8}$ to fractions having a common denominator.

Anſ. $\frac{576}{1152}$, $\frac{768}{1152}$, $\frac{864}{1152}$, $\frac{960}{1152}$, $\frac{1008}{1152}$.

3. Reduce $\frac{1}{2}$, $\frac{2}{3}$ of $\frac{5}{6}$, $7\frac{1}{4}$, and $\frac{3}{13}$ to a common denominator.

Anſ. $\frac{936}{1872}$, $\frac{1040}{1872}$, $\frac{1450}{1872}$, $\frac{432}{1872}$.

Rule II.

To reduce any given fractions to others, which ſhall have the leaſt common denominator.

1. By Prob. 2, page 70, find the leaſt common multiple of all the denominators of the given fractions, and it will be the common denominator required.

2. Divide the common denominator by the denominator of each fraction, and multiply the quotient by the numerator, and the product will be the numerator of the fraction required.

Example.

Example.

Reduce $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{1}{8}$ to fractions having the leaſt common denominator poſſible.

4)3 4 8

3 1 2

$4 \times 3 \times 2 = 24$ = leaſt common denominator.

$24 \div 3 \times 1 = 8$ the firſt numerator; $24 \div 4 \times 3 = 18$ the ſecond numerator; $24 \div 8 \times 7 = 21$ the third numerator.

Whence, the required fractions are $\frac{8}{24}$, $\frac{18}{24}$, $\frac{21}{24}$.

CASE VII.

To reduce a fraction of one denomination to the fraction of another, but greater, retaining the ſame value.

Rule.

Reduce the given fraction to a compound one by comparing it with all the denominations, between it and that denomination you would reduce it to; laſtly, reduce this compound fraction to a ſingle one, by caſe 5th, and you will have a fraction of the required denomination, equal in value to the given fraction.

Examples.

1. Reduce $\frac{1}{3}$ of a penny to the fraction of a pound.

By comparing it, it becomes $\frac{1}{3}$ of $\frac{1}{12}$ of $\frac{1}{20}$; which reduced by caſe 5th, will be $3 \times 1 \times 1 = 3$.

And $5 \times 12 \times 20 = 1200 = \frac{1}{400}$.

2. Reduce

2. Reduce $\frac{1}{4}$ of a farthing to the fraction of a pound. *Anſ.* $\frac{1}{1920}$.

3. Reduce $\frac{4}{8}$ of a penny to the fraction of a guinea. *Anſ.* $\frac{5}{1008}$ guinea.

4. Reduce $\frac{13}{19}$ of a ſhilling to the fraction of a moidore. *Anſ.* $\frac{1}{37}$ moid.

5. Reduce $\frac{4}{7}$ of an ounce to the fraction of a lb. Avoirdupois *Anſ.* $\frac{11}{28}$ lb.

6. Reduce 3s. 6d. to the fraction of a pound. *Anſ.* $\frac{7}{40}$.

7. Reduce 13s. 6d. to the fraction of a piſtole. *Anſ.* $\frac{27}{40}$ piſtole.

8. *Reduce $\frac{4}{5}$ of a pound to the fraction of a guinea. *Anſ.* $\frac{4}{7}$ guinea.

9. Reduce $\frac{7}{8}$ of a pwt. to the fraction of a pound Troy. *Anſ.* $\frac{7}{1920}$ lb.

10. Reduce $\frac{8}{9}$ of a lb. Avoirdupois to the fraction of 1 Cwt. *Anſ.* $\frac{1}{126}$ Cwt.

CASE VIII.

To reduce a fraction of one denomination to the fraction of another but leſs, retaining the ſame value.

RULE.

Multiply the given numerator by the parts of the denominations between it and that denomination you would reduce it to, for a new numerator, which place over the given

* $\frac{4}{5}£ = \frac{4}{5}$ of $\frac{20}{1} = \frac{4 \times 20}{5 \times 1} = \frac{80}{5}$ s. and $\frac{80}{5}$ of $\frac{1}{28} = \frac{80 \times 1}{5 \times 28}$ $= \frac{80}{140} = \frac{4}{7}$ guin.

given denominator; *Or*, only invert the parts contained in the integer, and make of them a compound fraction as before; then, reduce it to a ſimple one.

Examples.

1. Reduce $\frac{1}{400}$ of a pound to the fraction of a penny.

By comparing it the fraction will be $\frac{1}{400}$ of $\frac{20}{1}$ of $\frac{12}{1}$.

then $\left.\begin{array}{l} 1 \times 20 \times 12 \\ \hline 400 \times 1 \times 1 \end{array}\right\} = \frac{240}{400} = \frac{3}{5}$ *Anſwer.*

2. Reduce $\frac{1}{1280}$ of a pound to the fraction of a farthing. *Anſ.* $\frac{3}{4}$qr.

3. Reduce $\frac{1}{2688}$ of a guinea to the fraction of a penny. *Anſ.* $\frac{5}{8}$d.

4. Reduce $\frac{1}{17}$ of a moidore to the fraction of a ſhilling. *Anſ.* $\frac{12}{17}$s.

5. Reduce $\frac{1}{256}$ of a lb. Avoirdupois to the fraction of an ounce. *Anſ.* $\frac{4}{7}$oz.

6. *Reduce $\frac{4}{7}$ of a guinea to the fraction of a pound. *Anſ.* $\frac{4}{7}$£

7. Reduce $\frac{7}{1728}$ of a lb. Troy to the fraction of a pwt. *Anſ.* $\frac{7}{6}$pwt.

8. Reduce $\frac{1}{112}$ of a cwt. to the fraction of a lb. Avoirdupois. *Anſ.* $\frac{8}{9}$lb.

CASE

* $\frac{4}{7}$ Guin. $= \frac{4}{7}$ of $\frac{21}{1} = \frac{4 \times 28}{7 + 1} = 1\frac{1}{7}$s. & $1\frac{1}{7}$ of $\frac{1}{240} = \frac{11}{1680} = \frac{4}{7}$£

CASE IX.

find the value of a fraction in the known parts of the integer, as of coin, weight, meaſure, &c.

RULE.

Multiply the numerator by the parts in the next infer-r denomination, and divide the product by the de-ninator ; and if any thing remain, multiply it by the :t inferiour denomination, and divide by the de nom-tor as before, and ſo on, as far as neceſſary ; and quotients placed after one another, in their order, l be the anſwer required.

EXAMPLES.

1. What is the value of $\frac{5}{7}$ of a pound ?

```
 5
20
---
100
---
 14s.—2
    12
    --
  7)24
    --
   3d.—3
      4
      -
    7)12
      --
      1 5/7qr.
```

I multiply 5 by 20, the number of ſhillings in £. 1, and the product 100 I divide by the denominator 7, and get the quotient 14s. and 2 remaining, I multiply it by 12, and again dividing the product by 7, find the quotient 3d and 3 remains, which I multiply by 4, and dividing as before, the quotient is 1qr. and 5 remaining, I place it over the numerator, and find the anſwer, 14s. 3d. $1\frac{5}{7}$qr.

2. What

2. What is the value of $\frac{9}{24}$ of a ſhilling ?
Anſ. 4½d.

3. What is the value of $\frac{17}{19}$ of a Cwt ?
Anſ. 2qrs. 9lb. 10oz. $7\frac{7}{19}$dr.

4. What is the value of $\frac{4}{7}$ of a lb. Avoirdupois ?
Anſ. 12oz. $12\frac{4}{7}$dr.

5. What is the value of $\frac{3}{4}$ of a lb. Troy ?
Anſ. 7oz. 4pwt.

6. What is the value of $\frac{11}{17}$ of a ton ?
Anſ. 4Cwt. 2qrs. 12lb. 14oz. $12\frac{4}{17}$dr.

7. What is the value of $\frac{6}{9}$ of a yard ?
Anſ. 2qrs. $2\frac{3}{4}$n.

8. What is the value of $\frac{3}{4}$ of an ell Engliſh ?
Anſ. 4qrs. $1\frac{1}{2}$n.

9. What is the value of $\frac{4}{8}$ of a mile ?
Anſ. 6fur. 26p. 11ft.

10. What is the value of $\frac{9}{13}$ of a day ?
Anſ. 16h. 36m. $55\frac{5}{13}$s.

11. The value of $\frac{9}{14}$ of a guinea is demanded.
Anſ. 18s.

12. What is the value of $\frac{15}{16}$ of a dollar ?
Anſ. 5s. $7\frac{1}{2}$d.

13. What is the value of $\frac{3}{7}$ of a moidore ?
Anſ. 21s. $7\frac{1}{7}$d.

14. What is the value of $\frac{6}{7}$ of an acre ?
Anſ. 3r. $17\frac{1}{7}$p.

CASE.

CASE X.*

To reduce any given quantity to the fraction of any greater denomination of the same kind.

RULE.

Reduce the given quantity to the loweſt term mentioned, for a numerator; then reduce the integral part to the ſame term, for a denominator; which will be the fraction required.

EXAMPLES.

1. Reduce 14s. $3\frac{1}{4}$d. $\frac{5}{7}$ to the fraction of a pound.

20 integral part.	s.	d.
12	14	$3\frac{1}{4}$, $\frac{5}{7}$
240	12	
4	171	
960	4	
7	685	
6720 denominator.	7+5	
	4800 numerator.	

Anſ. $\frac{4800}{6720} = \frac{5}{7}$ſ.

2. Reduce $4\frac{1}{2}$d. to the fraction of a ſhilling.

Anſ. $\frac{3}{8}$s.

3. Reduce 2qrs. 9lb. 10 oz. $7\frac{1}{2}\frac{1}{9}$dr. to the fraction of a Cwt. *Anſ.* $\frac{1}{4}\frac{7}{9}$Cwt.

4. Reduce

* This caſe is the reverſe of the former, therefore proves it.

NOTE. If there be a fraction given with the ſaid quantity, it muſt be further reduced to the denominative parts thereof, adding thereto the numerator.

4. Reduce 7oz. 4pwt. to the fraction of a lb. Troy.
Anſ. $\frac{1}{3}$lb.

5. Reduce 2qrs. $2\frac{2}{3}$n. to the fraction of a yard.
Anſ. $\frac{2}{3}$yd.

6. Reduce 18s. to the fraction of a guinea.
Anſ. $\frac{9}{14}$ G.

7. Reduce 5s. $7\frac{1}{2}$d. to the fraction of a dollar.
Anſ. $\frac{1}{4}\frac{1}{8}$dol.

8. Reduce 21s. $7\frac{1}{2}$d. to the fraction of a moidore.
Anſ. $\frac{1}{3}$moid.

ADDITION OF VULGAR FRACTIONS.

Rule.

Reduce compound fractions to ſingle ones; mixed numbers to improper fractions; fractions of different integers to thoſe of the ſame; and all of them to a common denominator; then the ſum of the numerators written over the common denominator will be the ſum of the fractions required.

Examples.

1. Add $7\frac{4}{5}$, $\frac{5}{7}$ of $\frac{1}{8}$ and 7 together.
Firſt. $7\frac{4}{5}=\frac{39}{5}$, $\frac{5}{7}$ of $\frac{1}{8}=\frac{1}{5}\frac{5}{6}$ and $7=\frac{7}{1}$.
Then the fractions are $\frac{39}{5}$, $\frac{1}{5}\frac{5}{6}$; and $\frac{7}{1}$; therefore,

$$39\times56\times1=2184$$
$$15\times5\times1=75$$
$$7\times5\times56=1960$$

$$\frac{4219}{280}=15\frac{19}{280}$$

$$5\times56\times1=280$$

Or thus $\frac{2184+75+1960}{280}=15\frac{19}{280}$.

2. What

2. What is the sum of $\frac{7}{10}$ of 4£, $\frac{3}{4}$ of $\frac{1}{5}$ and $9\frac{1}{4}$?
Anſ. $12\frac{2}{3}\frac{8}{0}$.

3. Add $\frac{1}{3}$l. $\frac{1}{5}$s. and $\frac{4}{5}$d. together.
Anſ. 2s. $8\frac{64}{101}$d.

4. Add $\frac{1}{4}$ of a week, $\frac{1}{5}$ of a day, $\frac{1}{4}$ of an hour, and $\frac{1}{4}$ of a minute together.
Anſ. 2 days, 2 hours, 30 minutes, 45 ſeconds.

SUBTRACTION OF VULGAR FRACTIONS.

RULE.*

Prepare the fractions as in Addition, and the difference of the numerators, written above the common denominator, will give the difference of the fractions required—Note, a fraction is ſubtracted from a whole number, by taking the numerator of the fraction from its denominator, and placing the remainder over the denominator, then taking one from the whole number.

EXAMPLES.

1. From $\frac{3}{4}$ take $\frac{2}{7}$ of $\frac{5}{8}$.

$\frac{2}{7}$ of $\frac{5}{8}=\frac{10}{56}=\frac{5}{28}$. Then the fractions are $\frac{3}{4}$ and $\frac{5}{28}$.

3X28= 84
5X 4= 20
4X28=112 com. den.

$\frac{3}{4}=\frac{84}{112}$, and $\frac{5}{28}=\frac{20}{112}$, therefore, $\frac{84}{112}-\frac{20}{112}=\frac{64}{112}=\frac{4}{7}$ remainder.

2. From

* In ſubtracting mixed numbers, when the lower fraction (the ſubtrahend) is greater than the upper one (the minuend) you may, without reducing them to improper fractions, ſubtract the numerator of the ſubtrahend from the common denominator, and to that difference add the numerator of the minuend, and carry one to the integer of the ſubtrahend.

EXAMPLE.

From $19\frac{3}{4}$ take $12\frac{7}{8}$.——$19\frac{3}{4}-12\frac{7}{8}=6\frac{1}{4}$.

2. From $\frac{4}{5}\frac{9}{6}$ take $\frac{1}{3}$. *Anſ* $\frac{1}{4}\frac{9}{6}\frac{1}{6}$.

3. From $37\frac{1}{4}$ take $19\frac{4}{7}$. *Anſ.* $17\frac{1}{2}\frac{9}{8}$.

4. From $13\frac{1}{7}$ take $\frac{3}{4}$ of 15. *Anſ.* $2_{7}\frac{3}{8}$.

5. From £$\frac{1}{4}$ take $\frac{9}{10}$s. *Anſ.* 4s. $1\frac{1}{5}$d.

6. From $\frac{1}{7}$oz. take $\frac{2}{4}$pwt. *Anſ.* 13pwt. $12\frac{6}{7}$gr.

MULTIPLICATION OF VULGAR FRACTIONS.

Rule.

Reduce compound fractions to ſimple ones, and mixed numbers to improper fractions; then the product of the numerators will be the numerator, and the product of the denominators, the denominator of the product required. —*Note*, where ſeveral fractions are to be multiplied, if the numerator of one fraction be equal to the denominator of another, their equal numerators and denominators may be omitted.

Examples.

1. What is the continued product of $4\frac{1}{3}$, $\frac{1}{7}$, $\frac{1}{4}$ of $\frac{7}{8}$, and 6?

$4\frac{1}{3}=\frac{13}{3}$, $\frac{1}{4}$ of $\frac{7}{8}=\frac{1\times7}{4\times8}=\frac{7}{32}$, and $6=\frac{6}{1}$.

Then $\frac{13}{3}\times\frac{1}{7}\times\frac{7}{32}\times\frac{6}{1}=\frac{13\times1\times7\times6}{3\times5\times32\times1}=\frac{546}{480}=1\frac{71}{80}$ the anſwer.

2. Multiply $\frac{4}{11}$ by $\frac{5}{8}$. *Anſ.* $\frac{20}{88}$.

3. Multiply $5\frac{1}{4}$ by $\frac{1}{6}$. *Anſ.* $\frac{7}{8}$.

4. Multiply $\frac{1}{5}$ of 5 by $\frac{1}{4}$ of $\frac{3}{4}$. *Anſ.* $\frac{5}{16}$.

DIVISION OF VULGAR FRACTIONS.

Rule.*

Prepare the fractions as before; then, invert the divisor and proceed exactly as in Multiplication: The products will be the quotient required.

Examples.

1. Divide $\frac{1}{3}$ of 17 by $\frac{3}{4}$ of $\frac{6}{8}$.

$\frac{1}{3}$ of $17=\frac{1}{3}$ of $\frac{17}{1}$, $=\frac{17\times17}{3\times1}=\frac{17}{3}$, & $\frac{4}{3}$ of $\frac{6}{8}=\frac{12}{24}=\frac{1}{2}$;

therefore, $\frac{17}{3}\div\frac{1}{2}=\frac{17\times2}{3\times1}=\frac{34}{3}=11\frac{1}{3}$ the quotient required.

2. Divide $\frac{1}{7}$ by $\frac{1}{2}$. *Anſ.* $1\frac{4}{21}$.
3. Divide $12\frac{1}{3}$ by $\frac{1}{3}$ of 7. *Anſ.* $5\frac{8}{21}$.
4. Divide $5\frac{1}{8}$ by $7\frac{3}{4}$. *Anſ.* $\frac{41}{62}$.
5. Divide $\frac{3}{7}$ by 9. *Anſ.* $\frac{1}{21}$.
6. Divide $\frac{2}{3}$ of $\frac{1}{4}$ of $\frac{2}{3}$ by $\frac{1}{3}$ of $\frac{1}{4}$. *Anſ.* $\frac{8}{9}$.

DECIMAL FRACTIONS.

Decimal Fractions are of ſuch a nature, they they vary in the ſame proportion, and are managed by the ſame method of operation, as whole numbers are.

On this account, every proper fraction is ſuppoſed to be reducible to another, whoſe denominator ſhall be 10, 100, 1000, &c. viz. Unity with a number of cyphers annexed; and fractions with ſuch denominators are called *Decimal Fractions*: Such are $\frac{5}{10}$, $\frac{15}{100}$, $\frac{675}{1000}$, &c.

As

* To multiply a fraction by an integer, divide the denominator, or multiply the numerator by it; and to divide by an integer, divide the numerator, or multiply the denominator by it.

As the denominator of a decimal fraction is always 10, or 100, or 1000, &c. the denominators need not be expreſſed: For the numerator only may be made to expreſs the true value. For this purpoſe it is only required to write the numerator with a point before it at the left hand, to diſtinguiſh it from a whole number, when it conſiſts of ſo many figures as the denominator hath cyphers annexed to unity, or 1: So $\frac{5}{10}$ is written ,5; $\frac{33}{100}$,33; $\frac{735}{1000}$,735, &c.

Note. The point prefixed is called a ſeparatrix.

But if the numerator has not ſo many places as the denominator has cyphers, put ſo many cyphers before it, viz. at the left hand, as will make up the defect; ſo write $\frac{5}{100}$ thus, ,05; and $\frac{6}{1000}$ thus, ,006, &c. And thus do theſe fractions receive the form of whole numbers.

The 1ſt, 2d, 3d, 4th, &c. places of decimals counting from the left hand toward the right, are called primes, ſeconds, thirds, fourths, &c.

We may conſider unity as a fixed point from whence whole numbers proceed infinitely increaſing toward the left hand, and decimals infinitely decreaſing toward the right hand to 0, as in the following

TABLE.

C Millions	X Millions	Millions	C Thouſands	X Thouſands	Thouſands	Hundreds	Tens	Units		Tenth Parts	Hundredth Parts	Thouſandth Parts	XThouſandth Parts	CThouſandth Parts	Millionth Parts	XMillionth Parts	CMillionth Parts
9	8	7	6	5	4	3	2	1	,	2	3	4	5	6	7	8	9

From

From this table it is evident, that, in decimals, as well as in whole numbers, each figure takes its value by its diſtance from unit's place: If it be in the firſt place after units (or the ſeparating point) it ſignifies tenths; if in the ſecond, hundredths, &c. decreaſing in each place in a tenfold proportion.

Conſequently, every ſingle figure expreſſing a decimal has for its own denominator a unit or 1, with ſo many cyphers as its place is diſtant from unit's place: Thus ,2 in the decimal part of the table $=\frac{2}{10}$; ,3 $=\frac{3}{100}$; ,4 $=\frac{4}{1000}$ &c. And if a decimal be expreſſed by ſeveral figures, the denominator is 1, with ſo many cyphers as the loweſt figure is diſtant from unit's place. So ,357 ſignifies $\frac{357}{1000}$, and ,0063 $=\frac{63}{10000}$, &c.

Cyphers placed at the right hand of a decimal fraction, do not altar its value, ſince every ſignificant figure continues to poſſeſs the ſame place: So ,5, ,50, and ,500, are all of the ſame value, and each equal to $\frac{1}{2}$.

But cyphers placed at the left hand of a decimal, do alter its value, every cypher depreſſing it to $\frac{1}{10}$ of the value it had before, by removing every ſignificant figure one place further from the place of units. So ,6. ,06, ,006, all expreſs different decimals, viz. ,6, $\frac{6}{10}$; ,06, $\frac{6}{100}$; ,006, $\frac{6}{1000}$.

Hence may be obſerved the contrary effect of cyphers being annexed to whole numbers, and decimals.

It is likewiſe evident from the table, that, ſince the places of decimals decreaſe in a tenfold proportion from units downwards, ſo they conſequently increaſe in a tenfold proportion from the right hand towards the left, as the places of whole numbers do: For, ten hundredth parts make one tenth; ten tenths make 1; ten units ten; ten tens, one hundred, &c. viz. $\frac{10}{100}=\frac{1}{10}$, $\frac{10}{10}=1$, and $1\times 10=10$, which proves that decimals are ſubject to the ſame law of Notation, and conſequently of operation, as whole numbers are.

Decimal

Decimal fractions of unequal denominators are reduced to one common denominator, when there are annexed to the right hand of thoſe, which have fewer places, ſo many cyphers, as make them equal in places with that which has the moſt. So theſe decimals, ,5, ,06, ,455, may be reduced to the decimals, ,500, ,060, and ,455, which have all 1000 for their denominator.

Of decimals, that is the greateſt, whoſe higheſt figure is greateſt, whether they conſiſt of an equal or unequal number of places: Thus, ,5 is greater than ,459, for if it be reduced to the ſame denominator with ,459, it will be ,500.

A mixed number, viz. a whole number, with a decimal annexed, is equal to an improper fraction, whoſe numerator is all the figures of the mixed number, taken as one whole number, and the denominator that of the decimal part. So 45,309 is equal to $\frac{45309}{1000}$, as is evident from the method given to reduce a mixed number to an improper fraction: Thus, $45 \times 1000 + ,309 = \frac{45309}{1000}$ as above.

ADDITION OF DECIMALS.

RULE.

1. Place the numbers, whether mixed, or pure decimals, under each other, according to the value of their place

2. Find their ſum as in whole numbers, and point off ſo many places for decimals, as are equal to the greateſt number of decimal places in any of the given numbers.

EXAMPLES.

Examples.

1. Find the sum of 19,073+2,3597+223+,0197581 +3478,1+12,358.

19,073
2,3597
223
,0197581
3478,1
12,358

3734,9104581 the sum.

2. Required the sum of 429+21,37+355,003+ 1,07+1,7. *Ans.* 808,143.

3. Required the sum of 973+19+1,75+93,7164 +,9501. *Ans.* 1088,4165.

SUBTRACTION OF DECIMALS.

Rule.—Place the numbers according to their value; then subtract as in whole numbers, and point off the decimals as in Addition.

Examples.

1. Find the difference of 1793,13 and 817,05693.

From 1793,13
Take 817,05693

Remainder 976,07307

2. From 171,195 take 125,9176. *Ans* 45,2774.

3. From 219,1384 take 195,91. *Ans.* 23,2284.

4. From 480 take 245,0075. *Ans.* 234,9925.

MULTIPLICATION

MULTIPLICATION OF DECIMALS.

CASE I.

RULE 1.—Whether they be mixed numbers, or pure decimals, place the factors and multiply them as in whole numbers.

2. Point off so many figures from the product as there are decimal places in both the factors; and if there be not so many places in the product, supply the defect, by prefixing cyphers.

EXAMPLES.

1. Multiply ,02345
by ,00163

7035
14070
2345

,0000382235 the product.

2. Multiply 25,238 by 12,17 *Anſ.* 307,14646.
3. Multiply ,3759 by ,945. *Anſ.* ,3552255.
4. Multiply ,84179 by ,0385. *Anſ.* ,032408915.

To multiply by 10, 100, 1000, &c. remove the ſeparating point ſo many places to the right hand as the multiplier has cyphers.

So ,345 { Mult. by { 10 / 100 / 1000 } makes { 3,45 / 34,5 / 345

For ,345X10 is 3,450, &c.

CASE II.

To contract the operation, ſo as to retain ſo many decimal places in the Product as may be thought neceſſary.

RULE 1.—Write the unit's place of the multiplier under that figure of the multiplicand, whoſe place you would

would reſerve in the product; and diſpoſe of the reſt of the figures in a contrary order to what they are uſually placed in.

2. In multiplying, reject all the figures which are to the right hand of the multiplying digit, and ſet down the products, ſo that their right hand figures may fall in a ſtraight line below each other; obſerving to increaſe the firſt figure of every line with what would ariſe by carrying 1 from 5 to 15, 2 from 15 to 25, 3 from 25 to 35, &c from the preceding figures, when you begin to multiply, and the ſum will be the product required.

EXAMPLES.

1. It is required to multiply 56,7534916 by 5,376928, and to retain only five places of decimals in the product.

Contracted way.		Common way.	
56,7534916		56,7534916	
829673,5		5,376928	
283767460		45402793280	
17026050		1135069832	
3972740		51078144240	
340520		3405209496	
51080		397274	4412	
1130		1702604	748	
450		28376745	80	
305,15943		305,15943|80818048	

By the operation in the common way it is evident that all the figures, which are cut off at the right hand, by the perpendicular line, are wholly omitted in the contracted way, and the laſt product here is the firſt there; conſequently the reaſon of placing the multiplier in a reverſe order, muſt appear very plainly.

DIVISION

DIVISION OF DECIMALS.

RULE 1.—The places of decimal parts in the divisor and quotient counted together, must always be equal to those in the dividend; therefore divide as in whole numbers, and, from the right hand of the quotient, point off so many places for decimals, as the decimal places in the dividend exceed those in the divisor.

2. If the places of the quotient be not so many as the rule requires, supply the defect by prefixing cyphers to the left hand.

3. If at any time there be a remainder, or the decimal places in the divisor be more than those in the dividend, cyphers may be annexed to the dividend, or to the remainder, and the quotient carried on to any degree of exactness.

EXAMPLES.

1.	2.
219),11784075(00053808 7, &c.	,3719)38,0000(102,178,&c
1095	3719
834	8100
657	7438
1771	6620
1752	3719
1907	29010
1752	29038
1555	29770
1533	29752
22	18

In Example 1, the divisor having no decimals, the quotient must have so many as there are in the dividend. In Example 2, the dividend being an integer, must have at least so many cyphers annexed as there are decimals in the divisor, and so far the quotient will be whole numbers; then annexing more cyphers, the remaining figures in the quotient will be decimals, according to the rule.

3. 133)5737(43,1353+
4. 23,7)65321(2756,16+

EX 3.

5. *72)918,217(12753+
6. 25,17)315,6293(1253+
7. ,317)29,417(92+
8. 37,9)0059374(156+
9. ,375),173948375(463862+

CASE II.

To contract Diviſion, when there are many decimals in the dividend, and the diviſor is large

RULE I.—Whatever place of the dividend correſponds with the unit's place of the diviſor at the firſt ſtep of the diviſion, the ſame place muſt the figure of the quotient have.

2. In dividing, reject the laſt right hand figure of the diviſor, at every ſtep (inſtead of bringing down a figure, as in common) and make the laſt remainder the dividend for the new diviſor at every ſtep: Thus continue the diviſion until the diviſor ſhall be exhauſted.

99,5678)4,6789837568(,0469931 quotient
3,982712
99,567)696271
597402
99,56) 98869
89604
99,5) 9265
8955
99) 310
297
9) 13
9
Remainder 4

Here, the unit's place of the diviſor in the firſt ſtep falls under 7 in the place of hundredths in the dividend; therefore I put 4, the firſt quotient figure, in the place of hundredths by prefixing a cypher.

I have ſet down every diviſor, to explain the work; but you need only put a daſh over every figure rejected, as you proceed, to ſhow it is omitted.

When

* The following queſtions are left unpointed in the quotient, to exerciſe the learner.

When decimals or whole numbers are to be divided by 10, 100, 1000, &c. (viz. unity with cyphers) it is performed by removing the ſeparatrix, in the dividend, ſo many places toward the left hand, as there are cyphers in the diviſor.

EXAMPLES.

Dividing		The quot is
10	7654	765,4
100		76,54
1000		7,654
10000		,7654

REDUCTION OF DECIMALS.

CASE I.

To reduce a Vulgar Fraction to its equivalent Decimal.

RULE. Divide the numerator by the denominator, as in Diviſion of decimals, and the quotient will be the decimal required :—Or, ſo many cyphers as you annex to the given numerator, ſo many places muſt be pointed off in the quotient, and if there be not ſo many places of figures in the quotient, the deficiency muſt be ſupplied by prefixing ſo many cyphers before the quotient figures.

EXAMPLES.

1. Reduce $\frac{1}{8}$ to a decimal. 8)1,000

,125 *Anſ.*

2. Reduce $\frac{3}{8}$, $\frac{5}{8}$, and $\frac{2}{3}$ to decimals.
Anſwers. ,375 ,625. ,666+.

3. Reduce $\frac{1}{4}$, $\frac{1}{5}$, $\frac{3}{4}$, $\frac{2}{5}$, $\frac{4}{5}$, $\frac{1}{6}$, and $\frac{1}{8}$ to decimals.
Anſwers. ,25. ,5 ,75, ,333+ ,8. ,833+. ,875.

4. Reduce $\frac{5}{19}$, $\frac{27}{39}$, $\frac{12}{480}$, and $\frac{9}{36}$ to decimals.
Anſwers. ,263+. ,692+. ,025. ,25.

CASE

CASE II.

To reduce numbers of different denominations, as of Money, Weight and Meaſure, to their equivalent decimal values.

RULE 1.—Write the given numbers perpendicularly under each other, for dividends; proceeding orderly from the leaſt to the greateſt.

2. Oppoſite to each dividend, on the left hand, place ſuch a number, for a diviſor, as will bring it to the next ſuperiour denomination, and draw a line perpendicularly between them.

3. Begin with the higheſt and write the quotient of each diviſion as decimal parts on the right hand of the dividend next below it, and ſo on, until they are all uſed, and the laſt quotient will be the decimal ſought.

EXAMPLES.

1. Reduce 17s. 8¾d. to the decimal of a pound.

4	3,
12	8,75
20	17,729166, &c.
	,886458, &c. the decimal required.

Here, in dividing 3 by 4, I ſuppoſe two cyphers to be annexed to the 3, which make it 3,00, and ,75 is the quotient, which I write againſt 8 in the next line; this quotient, viz 8,75, being pence and decimal parts of a penny, I divide them by 12, which brings them to ſhillings and decimal parts; I therefore divide by 20, and (there being no whole number) the quotient is decimal parts of a pound.

2. Reduce 1, 2, 3, 4, and ſo on to 19 ſhillings, to decimals.

Shillings	1	2	3	4	5	6
Anſwers.	,05.	,1.	,15.	,2.	,25.	,3.
Shillings.	7	8	9	10	11	12
Anſwers.	,35.	,4.	,45.	,5.	,55	,6.

Shillings.

Shillings. 13 14 15 16 17 18 19
Anſwers. ,65. ,7. ,75. ,8 ,85. ,9. ,95.
Here when the ſhillings are even, half the number, with a point prefixed, is their decimal expreſſion; but if the number be odd, annex a cypher to the ſhillings, and then halving them you will have their decimal expreſſion.

*Reduce 1, 2, 3, and ſo on to 11 pence, to the decimals of a ſhilling.

Pence. 1 2 3 4 5 6
Anſwers. ,083+. ,166. ,25. ,333+. ,416+ ,5.
Pence. 7 8 9 10 11
Anſwers. ,583+. ,666+. ,75. ,833+. ,916+.

4. Reduce 1, 2, 3, &c. to 11 pence, to the decimals of a pound.

Pence 1 2 3 4
Anſwers. ,00416+. ,0083+. ,0125. ,01666+.
Pence. 5 6 7 8
Anſwers. ,0208+. ,025. ,02916+. ,0333+.
Pence. 9 10 11
Anſwers. ,0375. ,0416+. ,04583+.

5. Reduce 1, 2 & 3 farthings to the decimals of a penny. 1qr.=,25d. 2qr.=,5d. and 3qr.=,75d. *Anſwers.*

6. Reduce 1, 2 and 3 farthings to the decimals of a ſhilling.

Anſwers. 1qr.=,02083s+. 2qrs.=,04166s+. 3qrs.=,0625s.

7. Reduce 1, 2 and 3 farthings to the decimals of a pound.

Anſ. 1qr.=£,0010416+ 2qrs.=£,002083+ 3qrs.=£,003125.

8. Reduce 13s. 5½d. to the decimal of a pound.

Anſ. ,6[illegible]9+.

9. Reduce 7 Cwt. 3qrs. 17lb. 10oz. 12dr. to the decimal of a ton. *Anſ.* ,39538+.

10. Reduce

* The anſwers to this queſtion are the ſame as the decimal parts of a foot.

10. Reduce 1ooz. 13pwt. 9gr. to the decimal of a pound Troy. *Anſ.* ,889062 5.

11. Reduce 3qrs. 3n. to the decimal of a yard. *Anſ.* ,9375.

CASE III.

To find the decimal of any number of ſhillings, pence and farthings, by Inſpection.

RULE 1.—Write half the greateſt even number of ſhillings for the firſt decimal figure.

2. Let the farthings in the given pence and farthings poſſeſs the ſecond and third places; obſerving to increaſe the ſecond place, or place of hundredths, by 5, if the ſhillings be odd, and the third place by 1, when the farthings exceed 12, and by 2 when they exceed 36.

3. If more than three places be needful, divide half the number of farthings in the given pence and farthings (rejecting 24qrs. firſt, if there be ſo many) by 12, and the quotient, written after the three places before found, will give the decimal required.

EXAMPLES.

1. Find the decimal of 13s. 9¾d. by inſpection.

,6 . . = ½ of 12s.
5 for the odd ſhilling.
39 the farthings in 9¾d.
Add 2 for the exceſs of 36.

,691 = decimal required.

2. Find by inſpection, the decimal expreſſions of 18s. 3¼d. and 17s. 8½d. *Anſ.* £,914 and £,885.

3. Value the following ſums, by inſpection, and find their total, viz. 15s. 3d. + 8s. 11½d. + 10s 6¼d. + 1s. 8½d. + ½d. + 2¾d. *Anſ.* £1,834 the total.

CASE

CASE IV.

To find the value of any given decimal in the terms of the Integer.

RULE 1.—Multiply the decimal by the number of parts in the next leſs denomination, and cut off ſo many places for a remainder, to the right hand, as there are places in the given decimal.

2. Multiply the remainder by the next inferiour denomination, and cut off a remainder as before.

3. Proceed in this manner through all the parts of the integer, and the ſeveral denominations, ſtanding on the left hand, make the anſwer.

EXAMPLES.

1. Find the value of ,73968 of a pound.

20

14,79360

12

9,52320

4

2,09280 *Anſ.* 14s. 9½d.

2. What is the value of ,679 of a ſhilling ?
Anſ. 8,148d.

3. What is the value of £,9999 ?
Anſ. 19s. 11¾d. $\frac{9}{10}$—or £1.

4. What is the value ,617 of a Cwt. ?
Anſ. 2qrs. 13lb. 1oz. 10$\frac{6}{10}$dr.

5. What is the value of ,8593 of a lb. Troy ?
Anſ. 10oz. 6pwt. 5gr.

6. What is the value of ,397 of a yard ?
Anſ. 1qr. 2n[illegible]

7. What [illegible]

7. What is the value of ,8469 of a degree?
Anſ. 58m. 6fur. 35po. oft. 11in.

8. What is the value of ,569 of a year?
Anſ. 207d. 16h. 26m. 24ſec.

CASE V.

To find the value of any decimal of a pound by Inſpection.

RULE.—Double the firſt figure, or place of tenths, for ſhillings, and if the ſecond figure be 5, or more than 5, reckon another ſhilling; then after the 5 is deducted, call the figures in the ſecond and third places ſo many farthings, abating 1 when they are above 12, and 2 when above 36, and the reſult will be the anſwer.

Note. When the decimal has but 2 figures, if any thing remain after the ſhillings are taken out, a cypher muſt be annexed to the right hand, or ſuppoſed to be ſo.

EXAMPLES.

1. Find the value of £,876 by inſpection.
16s. =double of 8.
1s. for the 5 in the ſecond place, which is to (be taken out of 7,
and 6½d.=26 farthings, remain to be added;
deduct ¼d. for the exceſs of 12.

17s. 6¼d. the *Anſ.*

2. Find by inſpection, the value of £,49.
8s. - -=double of 4.
1s. - - for the 5 in the place of hundredths.
10d.=40 farthings, a 0 being annexed to the (remaining 4.
Ded. ¼d. for the exceſs of 36.

9s. 9½d. the anſwer.

3. Find

3. Find the value of £,097 by inſpection.

Anſ. 1s. 11¼d.

4. Value the following decimals, by inſpection, and find their ſum, viz. £,185+£,537 +£,916+£,24 +£,5+£,25+£,09+£,008. *Anſ.* £3 16s.6d.

FEDERAL MONEY.

The pupil being well acquainted with decimals, it will be proper to introduce here an account of the Federal Money.

As the Money of account proceeds in a decuple, or tenfold proportion, ſo any number of Dollars, Dimes, Cents and mills, is ſimply the expreſſion of Dollars and Decimal parts of a Dollar:—Thus, 9 Dollars and 8 Dimes are expreſſed $9,8=9\frac{8}{10}$ doll.—12 Dollars, 4 Dimes, and 7 Cents, thus, $12,47=12\frac{47}{100}$ doll.—20 Dollars, 3 Dimes, 4 Cents, 5 Mills, thus, $20,345=20\frac{345}{1000}$ doll. 100 Dollars and 9 Mills, thus, 100,009 $=100\frac{9}{1000}$ doll. and 50 Dollars, 5 Cents, thus, 50,05 $=50\frac{5}{100}$ doll. Wherefore it is, in all reſpects, added, ſubtracted, multiplied and divided, the ſame as decimals; and, of all Coins, it is the moſt ſimple.

Note.		make one		marked
	10 Mills		Cent.	m. c.
	10 Cents		Dime.	d.
	10 Dimes		Dollar.	D.
	10 Dollars		Eagle.	E.

ADDITION OF FEDERAL MONEY.

Add $25\frac{1}{2}$ Eagles, 7 Dollars, 8 Dimes, 3 Cents, 4 Mills; 125 Dollars, 8 Cents; 5 Eagles, 9 Mills; 18 Dollars, 7 Cents and 4 Mills, together.* 1ſt.

* It may be obſerved that the ſum exhibits the particular number of each different piece of money contained in it, viz. 455997 mills=45599$\frac{7}{10}$ cents= 4559$\frac{97}{100}$ dimes=455 E. D. d. c. m.
$\frac{997}{1000}$ dollars=45$\frac{5997}{10000}$ eagles=45 5, 9 9 7.

Alſo,

	Eagles.	*Dollars.*	*Dimes.*	*Cents.*	*Mills.*
1ſt.	25	5			
2d.		7,	8	3	4
3d.	12	5,	0	8	0
4th.	5	0,	0	0	9
5th.	1	8,	0	7	4
Sum	45	5,	9	9	7

Note. That Dollars occupy the firſt place at the left hand of the comma, and Eagles, all the places at the left of Dollars: But Eagles and Dollars, reckoned together, expreſs the number of Dollars contained in the ſum, as 349 is 34 Eagles and 9 Dollars; equal to 349 Dollars. &c.

SUBTRACTION.

	E. D. d. c. m.	D. d. c. m.	D. d. c. m.
From	13479,8 1 5	495641,0 0 1	798,
Take	8985,9 4 6	218796,7 9 5	459,3 7 9
Rem.	4493,8 6 9	276844,2 0 6	338,6 2
Proof.	13479,8 1 5		

MULTIPLICATION.

When you have pointed off the decimals in the product, according to the rule in Multiplication of decimals, all beyond the Mills, or third place of decimals, are decimal parts of a Mill.

Bought 37 horſes for ſhipping, at 48, 5 7 3 per head: What came they to ?

D. d. c. m.

D. d. c. m.

Alſo, the names of the Coins, leſs than a dollar, are ſignificant of their values.

For the *Mill*, which ſtands in the 3d place, at the right hand of the comma, or place of thouſands, is contracted from *Mille*, the Latin for *Thouſand*:—*Cent*, which occupies the ſecond place, or place of Hundredths, is an abbreviation of *Centum*, the Latin for *Hundred*:—And *Dime*, which is in the firſt place, or place of *tenths, is derived* from *Diſme* the French for Tenths.

D. d. c. m.		D. d. c. m.
48, 5 7 3	Mult	45,8 4 6
3 7	by	23,0 9 4
340011		183384
1456 9		412[illegible]4
		1375380
		91692
Anf. 1797,201 d. c m.		*Anf.* 1058,767$\frac{124}{1000}$. D. d. c. m.

DIVISION.

1. If 1000 oranges coſt 10 dollars what is that a piece?

D.d c. D.d.c.
1000)10,0 0(0,0 1 *Anf.**
10 0 0

D. d. c.

2. If 3730 buſhels of corn coſt 2025,3 9. what is that per buſhel?

D. d. c D.d.c.
3730)2025,39(0,5 4 3 *Anf.*
1865 0

16039
14920

11190
11190

3. Divide 12976 dollars between 7 men

7)12976

1853,714$\frac{2}{7}$ *Anf.* in dol. dim. &c.
D d.c.m

DECIMAL

* And here I would remind the learner, that, when he has brought down all his whole numbers, or dollars, in the dividend, he muſt place a comma in the quotient; and if when he has brought down *the next* figure, he cannot have the diviſor *once, he muſt place* a cypher at the right hand of the comma, *in the place of dimes,*

Decimal Tables of Coin, Weight, and Measure.

TABLE I. Coin. £1 the Integer.

Shil.	dec.	Shil.	dec.
19	,95	9	,45
18	,9	8	,4
17	,85	7	,35
16	,8	6	,3
15	,75	5	,25
14	,7	4	,2
13	,65	3	,15
12	,6	2	,1
11	,55	1	,05
10	,5		

Pence.	Decimals.
11	,045833
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Farth.	Decimals.
3	,003125
2	,0020833
1	,0010416

TABLE II. Coin & Long Meas. 1 Shilling & 1 Foot the Integer.

Pence & Inches.	Decimals.
11	,916666
10	,833333
9	,75
8	,666666
7	,583333
6	,5
5	,416666
4	,333333
3	,25
2	,166666
1	,083333

Farthings.	Decimals
3	,0625
2	,041666
1	,020833

TABLE III. Troy Weight. 1 Pound the Integer. Ounces the same as Tab. II.

Penny-weights.	Decimals
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Grains.	Decimals
12	,002083
11	,00191
10	,001736
9	,001562
8	,001389
7	,001215
6	,001042
5	,000868
4	,000694
3	,000521
2	,000347
1	,000173

1 Oz. the Integer. Pennyweights the same as Shilling in Tab. I.

Grains.	Decimals
12	,025
11	,022916
10	,020833
9	,01875
8	,016666
7	,014583
6	,0125

Grains.	Decimals.
5	,010416
4	,008333
3	,00625
2	,004166
1	,002083

TABLE IV. Avoirdupois Wt. 1 Lb. the Integer.

Qrs.	Decimals.
3	,75
2	,5
1	,25

Pounds	Decimals
27	,24107 1
26	,232143
25	,223214
24	,214286
23	,205357
22	,196428
21	,1875
20	,178571
19	,169642
18	,160714
17	,151786
16	,142857
15	,133928
14	,125
13	,116071
12	,107143
11	,098214
10	,089286
9	,080357
8	,071428
7	,0625
6	,053571
5	,044643
4	,035714
3	,026786
2	,017857
1	,008928

Ounces	Decimals.
15	,008370
14	,007812
13	,007254
12	,006696

Carried over.

Brought over.	
Ounces.	Decimals.
11	,006138
10	,00558
9	,005022
8	,004464
7	,003906
6	,003348
5	,00279
4	,002232
3	,001674
2	,001116
1	,000558
qrs. of ozs.	Decimals.
3	,000418
2	,000279
1	,000139

TABLE V.
AVOIRDUPOIS WT.
1lb. the Integer.

Ounces.	Decimals.
15	,9375
14	,875
13	,8125
12	,75
11	,6875
10	,625
9	,5625
8	,5
7	,4375
6	,375
5	,3125
4	,25
3	,1875
2	,125
1	,0625
Drams.	Decimals.
15	,059493
14	,055587
13	,051681
12	,047775
11	,043868
10	,039962
9	,036056
8	,032150

Drams.	Decimals.
7	,027343
6	,023437
5	,019531
4	,015625
3	,011718
2	,007812
1	,003906

TABLE VI.
CLOTH MEASURE.
1 Yard the Integer.

Quarters.	Decimals.
3	,75
2	,5
1	,25
Nails.	Decimals.
3	,1875
2	,125
1	,0625

TABLE VII.
LONG MEASURE.
1 Mile the Integer.

Yards.	Decimals.
1000	,568182
900	,511364
800	,454545
700	,397727
600	,34
500	,284091
400	,227272
300	,170454
200	,113636
100	,056818
90	,051136
80	,045454
70	,039773
60	,034091
50	,028409
40	,022727
30	,017045
20	,011364
10	,005682
9	,005114
8	,004545

Yards.	Decimals.
7	,003977
6	,003409
5	,002841
4	,002273
3	,001704
2	,001136
1	,000568
Feet.	Decimals.
2	,0003787
1	,0001892
Inches.	Decimals.
6	,0000947
5	,0000789
4	,0000632
3	,0000474
2	,0000316
1	,0000158

TABLE VIII.
LIQUID MEASURE.
1 Gall. the Integer.
Quarts the same as qrs. in Tab. VI.

1 Pint	,125
3 Gill	,09375
2	,0625
1	,03125

TABLE IX.
TIME.
1 Year the Integer.
Months the same as Pence in Tab. II.

Days	Decimals.
365	1,000000
300	,821928
200	,547945
100	,273973
90	,246575
80	,219178
70	,191781
60	,164383
50	,136986
40	,109589

Carried over.

Brought over.		Hours.	Decimals.	Hours.	Decimals.
Days.	Decimals.	21	,875	3	,125
30	,082192	20	,833333	2	,083333
20	,054794	19	,791666	1	,041666
10	,027397	18	75	Minutes.	Decimals.
9	,024657	17	,708333	30	,020833
8	,021918	16	,666666	20	,013888
7	,019178	15	,625	10	,006944
6	,016438	14	,583333	9	,00625
5	,013698	13	,541666	8	,005555
4	,010959	12	,5	7	,004861
3	,008419	11	,458333	6	,004166
2	,005479	10	,416666	5	,003472
1	,002739	9	,375	4	,002777
1 Day the Integer.		8	,333333	3	,002083
Hours.	Decimals.	7	,291666	2	,001388
23	,958333	6	,25	1	,000694
22	,916666	5	,208333		
		4	,166666		

COMPOUND MULTIPLICATION.

Is extremely useful in finding the value of goods, &c. And, as in Compound Addition we carry from the lowest denomination to the next higher, so we begin and carry in Compound Multiplication; one general rule being, to multiply the price by the quantity.

CASE I.

When the quantity does not exceed 12 yards, pounds, &c. set down the price of 1, and place the quantity underneath the least denomination, for the multiplier, and, in multiplying by it, observe the same rules for carrying from one denomination to another, as in Compound Addition.

Introductory Examples.

	1. £. s. d.	2. £. s. d.	3. £. s. d.
Multiply	15 17 1	25 12 8	45 9 10
by	2	3	4
	4	5	6
	67 18 6½	19 6 8¼	13 12 11
	5	6	7
	7	8	
	31 16 8¼	12 17 10½	
	8	9	

Practical Questions.

What will 9 yards of cloth, at 5s. 4d. per yard, come to?

	£	s.	d.	
	0	5	4	price of one yard.
Multiply by		9		yards.
Anf.	£2	8	0	price of 9 yards.

Queſtions.

			s.	d.	
2d.	3	yards, at	15	4	per yard.
3d.	6	—— at	9	10	
4th.	9	—— at	13	7½	

CASE II.

When the multiplier, that is, the quantity, is above 12, you muſt multiply by two ſuch numbers, as when multiplted toge ther, will produce the given quantity.

Examples.

1. What will 144 yards of cloth coſt, at 3s. 5½d. per *yard?*

	£	s.	d.	
	0	3	5½	price of one yard.
Multiplied by			12	
Produces	2	1	6	price of 12 yards.
Multiplied by			12	
Anſ. £24	18	0		price of 144 yards.

Queſtions.	s.	d.	*Anſwers.* £.	s	d.
2d. 24 yards at 6	3¾		per yard. = 7	11	6
3d. 27 —— at 9	10		—— = 13	5	6
4th. 44 —— at 12	4½		—— = 27	4	6

CASE III.

When the quantity is ſuch a number, as that no two numbers in the table will produce it exactly : Then multiply by two ſuch numbers as come the neareſt to it ; and for the number wanting multiply the given price of one yard by the ſaid number of yards wanting, and add the products together for the anſwer ; but if the product of the two numbers exceed the given quantity, then find the value of the overplus, which ſubtract from the laſt product, and the remainder will be the anſwer.

EXAMPLES.

1. What will 47 yards of cloth, at 17s. 9d. per yard come to ?

	£.	s	d.	
	0	17	9	price of one yard.
Multiplied by			5	
Produces	4	8	9	price of five yards.
Multiplied by			9	
Produces	39	18	9	price of 45 yards.
Add	1	15	6	price of 2 yards.
Anſ.	41	14	3	price of 47 yards.

Note.

Note.—This may be performed by firſt finding the value of 48 yards, from which, if you ſubtract the price of 1, the remainder will be the anſwer, as above.

Queſtions. Yds.	s.	d.		*Anſwers.* £	s.	d.
2d. 75 at	5	$7\frac{1}{2}$	per yard, =	21	1	$10\frac{1}{2}$
3d. $67\frac{1}{2}$ —	16	$3\frac{1}{4}$	—— =	54	18	$3\frac{1}{4}$
4th. 59 —	9	7	—— =	28	5	5

CASE IV.

When the quantity is any number above the Multiplication Table: Multiply the price of 1 yard by 10, which will produce the price of 10 yards: This product multiplied by 10 will give the price of 100 yards; then, if the quantity exceed hundreds, you muſt multiply the price of one hundred by the number of hundreds in your queſtion; the price of ten by the number of tens; and the price of unity, or 1, by the number of units; Laſtly, add theſe ſeveral products together, and the ſum will be the anſwer.

EXAMPLES.

1. What will 359 yards of cloth at 4s. $7\frac{1}{2}$d. per yard amount to?

£	s.	d.	
0	4	$7\frac{1}{2}$	price of one yard.
		10	
2	6	3	price of 10 yards.
		10	
23	2	6	price of 100 yards.
		3	
69	7	6	price of 300 yards.
5 times the price of 10 yards = 11	11	3	price of 50 yards.
9 times the price of 1 yard = 2	1	$7\frac{1}{2}$	price of 9 yards.
Anſ. £83	0	$4\frac{1}{2}$	price of 359 yards.

	Queſtions.	s.	d.		£.	s.	d.
2d.	297 yards, at	17	$3\frac{1}{2}$	per yard, =	256	15	$7\frac{1}{2}$
3d.	473 ———	9	$11\frac{1}{4}$	——— =	235	0	$5\frac{1}{4}$
4th.	512 ———	15	10	——— =	405	6	8

CASE V.

When the quantity does not exeeed 200, nor the price 12 pence, then by the pence table, find what it comes to, at one penny per yard, &c. and multiplying this ſum by the number of pence in the price, the product will be the anſwer.

EXAMPLES.

1. What will 129 yards coſt, at $9\frac{1}{4}$d. per yard.

£. s. d.
129 pence=0 10 9 the price at 1d. per yard ?
9

4 16 9 the price at 9d. per yard.
Half of 10s. 9d. = 5 $4\frac{1}{2}$ the price at $\frac{1}{2}$d. per yard.
1 fourth of 10s. 9d.= 2 $8\frac{1}{4}$ the price at $\frac{1}{4}$d. per yard.

Anſ. £5 4 $9\frac{3}{4}$ the price at $9\frac{3}{4}$d. per yard.

Queſtions. Yds				*Anſwers.* £.	s.	d.
2d	$148\frac{1}{2}$ at	$11\frac{1}{4}$d.	per yard, =	6	19	$2\frac{1}{2}$
3d.	75 —	7	——— =	2	3	9
4th.	$63\frac{1}{4}$ —	$3\frac{3}{4}$	——— =	0	19	10

CASE VI.

To find the value of one hundred weight :—As 112 is the groſs hundred, ſo 112 farthings are=2s. 4d. and 112 pence=9s. 4d ; therefore if the price be farthings, or not more than 3d. multiply 2s. 4d. by the farthings in the price of 1lb ; or, if the price be pence, multiply 9s. 4d. by the pence in the price of 1lb. and in either caſe the product will be the anſwer.

EXAMPLES.

EXAMPLES.

1. What will 1Cwt. of chalk come to, at $1\frac{1}{2}$d. per lb.?

	£.	s.	d.	
112 farthings =	0	2	4	price of 1Cwt. at $\frac{1}{4}$d. per lb.
$1\frac{1}{2}$d. =			6	farthings in the price.
Anſ.	£0	14	0	price of 1Cwt. at $1\frac{1}{2}$d. per lb.

2. 1Cwt. of tin at $2\frac{1}{4}$d. per lb.

		s.	d.
Price of 1Cwt. at $\frac{1}{4}$d. per lb.		2	4
Farthings in the price of 1 lb.			9
Price of 1Cwt. at $2\frac{1}{4}$d. per lb.	*Anſ.* £1	1	0

3. 1Cwt. of lead at 7d. per lb.

	s.	d.
Price of 1Cwt. at 1d. per lb.	9	4
Pence in the price of 1lb.		7
Price of 1Cwt. at 7d. per lb.	£3	5 4

Queſtions. Cwt.	*Anſwers.* £.	s.	d.
4th. 1 of Copper at $\frac{1}{4}$d. per lb.	= 0	7	0
5th. 1 ditto —— $2\frac{1}{2}$d. $\frac{1}{2}$q.	= 1	4	6
6th. 1 ditto —— $4\frac{1}{2}$d.	= 2	2	0

CASE VII.

To find the value of two or more hundreds, by having the price of one pound:—Firſt, find the price of 1Cwt. by the laſt Caſe, and then proceed to find the value of the whole by Caſe 1ſt, or 2d, as the queſtion may require.

EXAMPLES.

1. What is the value of $5\frac{1}{2}$cwt. of ſugar, at 6d. per lb?

£. s. d.

£.	s.	d.	
	0	9	4 price of 1Cwt. at 1d. per lb.
		6	
1	16	0	price of ditto at 6d. per lb.
		5	
14	0	0	price of 5Cwt.
qr. of Cwt.= 0	14	0	price of ¼Cwt.
Anſwer, £14	14	0	price of 5¼Cwt.

Queſtions. Cwt.		*Anſwers.* £. s. d.
2d. 4	of ſugar at 2½d. per lb.	= 4 13 4
3d. 8½	——— 5d. ———	=19 16 8
4th. 7	——— 4¾d. ———	=15 10 4

CASE VIII.

To find the value of a hundred weight when the price of 1lb. *is any number of pounds and ſhillings; or ſhillings, pence, and farthings* :—Multiply the price of 1lb. by 7, its product by 8, and this product by 2: which laſt product will be anſwer required.

Examples.

What will 1Cwt. of tobacco coſt, at 5s. 7½d. per lb.?

£.	s.	d.	
0	5	7½	price of 1lb.
		7	
1	19	4½	price of 7lb.
		8	
15	15	0	price of 56lb. or ½Cwt.
		2	
Anſ. £31	10	0	price of 112lb. or 1Cwt.

Queſtions.

Queſtions.	s.	d.	*Anſwers.* £.	s.	d.
2d. 1 Cwt. at	3	10½ per lb.	= 21	14	0
3d. 1 ditto—	9	6 ——	= 53	4	0
4th. 1 ditto—	16	11½ ——	= 94	19	4

COMPOUND DIVISION

Is the dividing of numbers of different denominations; In doing which, always begin at the higheſt, and when you have divided that, if any thing remains, reduce it to the next lower denomination, and ſo on, till you have divided the whole; taking care to ſet down your quotient figures under their reſpective denominations.

Introductory Examples.

1.

	£.	s.	d.	
Divide	549	17	9	by 5.
Quotient £	109	19	6½	

2.

£.	s.	d.
4)731	5	10¼

3.

£.	s.	d.
2)97	19	10½

4.

£.	s.	d.
6)37	11	4¾

5.

£.	s.	d.
7)193	15	9½

6

T.	Cwt.	qr.	lb.	oz.	dr.
3)29	13	2	25	12	13

7

lb.	oz.	pwt.	gr.
12)529	10	7	14

8

Deg.	m.	f.	p.	ft.	in.	bc.
6)97	55	7	35	4	2	1

9

lb	℥	ʒ	℈	gr
12)37	10	5	1	12

10. Suppoſe that two places lie eaſt and weſt of each other, and it is found by obſervation, that it is noon at the former, 2 hours 6′ 30″ ſooner than at the latter; how many degrees are they aſunder?

4′) 2h 6′ 30″ Reduce the hours and minutes to minutes, then, minutes divided by 4′, give degrees in the quotient.

31° 37′ 30″ *Anſ.*

11. The longitude of Cambridge is 4h. 44′ 17″, and that of Philadelphia, 5h. 0′ 43″; how many degrees difference?

5h. 0′ 43″
4 44 17

4′)0 16 26

4° 6′ 30″ *Anſ.*

PRACTICAL QUESTIONS.

CASE I.

Having the price of any number of yards, &c. within the pence table, to find the price of unity, or 1 *yard*:—Proceed by ſetting down the price and dividing it by the quantity; which quotient will be the price of 1 yard, required; but if the quantity exceed 12, then divide by 2 ſuch numbers, as when multiplied together, will produce the quantity, and the laſt quotient will be the value of 1 yard, required.

Note. This caſe proves the firſt and ſecond caſes in Compound Multiplication.

1. If 9 yards of cloth coſt £4 3s. 7½d, what is it per yard?

£	s.	d.
9)4	3	7½
0	9	3½ *Anſ.*

2. If

2. If 7 ells coſt £5 17s. 5d. what coſt 1 ell?
3. If 11 ſheep coſt £6 5s. 9d. what did each coſt?
4. If 12 gallons of rum coſt £8 11s. 9½ what is it per gallon?

Note. When the given quantity (or diviſor) is large and not a compoſite number, the operation may be performed by long diviſion.

CASE II.

Having the price of a hundred weight, to find the price of 1lb ——Divide the given price by 8, that quotient by 7, and this quotient by 2, and the laſt quotient will be the price of 1lb. required.

1. If 1cwt. of flax coſt £2 7s. 8d. what is that per lb.?

£	s.	d.	
8)2	7	8	
7)0	3	11½	
2)0	0	10 6/7	qr.
0	0	5 3/14	d. price of one pound.

2. At £3 10s. per Cwt. what coſt 1lb.?
Anſ. 7½d.
3. At £6 6s. per Cwt. what coſt 1lb.?
Anſ. 1s. 1¼d.
4. At £42 11s. 8d. per Cwt. what coſt 1lb.?
Anſ. 7s. 7¼d.

CASE III.

Having the price of ſeveral hundred weight, to find the price per lb.——Divide the whole price by the number of hundreds, which will give the price per Cwt. and then proceed as in the laſt Caſe.

1. If 5Cwt. of ſugar coſt £13 8s. 4d. what is that per lb.?

£ s. d.

£	s.	d.	
5)13	8	4	
8) 2	13	8	price of 1Cwt.
7) 0	6	8½	price of 14lb. or ¼Cwt.
2) 0	0	1 1½	price of 2lb. or $\frac{1}{56}$Cwt.
0	0	5¾	price of 1lb.

2. If 8Cwt. of cocoa coſt £15 17s. 4d. what is that per lb. ? *Anſ.* 4¼d.

3. If 3¼Cwt. of ſugar coſt £9 17s. 2d. what is that per lb. ? *Anſ.* 6½d.

4. If 1¾Cwt. of cotton wool coſt £6 10s. 8d. what is that per lb. ? *Anſ.* 8d.

Note. This Caſe proves the 7th in Compound Multiplication.

CASE IV.

Having the price of any number of yards, &c. to find the price of 1 *yard* :——Divide the price by the quantity, beginning at the higheſt denomination, and, if any thing remain, reduce it into the next, and every inferiour denomination, and, at each reduction, divide as before, remembering each time, to add the odd ſhillings, pence, &c. if there be any, and you will have the value of unity required.

Note. If there be ¼, ½, or ¾ of a yard, pound, &c. multiply both the price and quantity by 4, and then proceed as above directed.

1. If 95½lb. of figs coſt £16 13s. 6¾d. what are they per lb. ?

	lb.		£	s.	d.
Quantity =	95½	Price =	16	13	6¾
Mult. by	4				4

Produces 382 for a divr. Pro. £65 14 3 for a divid.
£. s. d.

£ s. d. £ s. d.
382)66 14 3 (0 3 5¼ $\frac{252}{382}$ per lb.
20

382)1334(3
1146

188
12

382)2259(5
1910

349
4

382)1396(3
1146

250

2. If 147 bushels of rye cost £47 12s. 6d. what is it per bushel? *Ans.* 6s. 5¼d.

3. If 33¼ yards of baize cost £25 13s. 9½d. what is it per yard? *Ans.* 15s. 5¼d. $\frac{95}{133}$.

Note. This proves the 3d and 4th cases in Multiplication.

REDUCTION OF COINS.

RULES for reducing the Federal Coin, and the currencies of the several United States; also English, Irish, Canada, Nova-Scotia, Livres Tournois, and Spanish milled Dollars, each to the par of all the others.

I. *To reduce New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and Virginia currency.*

1. To Federal Money.

Rule.—Reduce the shillings, pence and farthings, to decimals, by Inspection, (Case 3d, Dec. Frac.) divide the whole by 3, putting the comma one figure further to the right hand in the quotient than in the pounds of the dividend,

and

and the quotient will be the anſwer in dollars, cents and mills.

1. Reduce £349 19s. 1d. to dollars.

,9 = ½ the ſhillings.
,05 = odd ſhillings.
4 = qrs. in a 1d.

,954 = decimal.

3)349,954 D. c. m.
1166,513 = 1166,51 3 *Anſwer.*

2. Reduce 19s. 1¼d. to dollars.

,9
,05
7

,957 = decimal.

3),957 D. c.
3,19 = 3 19

3. Reduce 1s. to cents.

1s. = ,05 then

3)0 5 c. m.
0,166⅔ = 16 6⅔

4. Reduce 1d.

1d. = 4qrs.

3),004 c. m.
001,3⅓ = 1 3⅓

5. Reduce 1qr.

1qr. = ,001041 and

3),0 01 041
0,00,347 = 3 47/100 mills.

2. To New York and North Carolina currency.

Rule.—Add one third to the given ſum.

Reduce £100 N. Hampſhire, &c. to New-York, &c.

£.
3)100
+ 33 6 8

£133 6 8 *Anſ.*

3. To Pennſylvania, New-Jerſey, Delaware, and Maryland currency.

Rule.—Add one fourth to the given ſum.

Reduce £100 New-Hampſhire, &c. to Pennſylvania, &c.

4)100
+ 25

£125 *Anſ.*

4. To South Carolina and Georgia currency.

Rule.—Multiply the given ſum by 7, and divide the product by 9.

Reduce £100 New-Hampſhire, &c. to South Carolina, &c.

100
7

9)700

£77 15 6⅔ *Anſ.*

5. To Engliſh Money.

Rule.—Deduct one 4th from the given ſum.

Reduce

Reduce £100 New-Hampſhire, &c. to Engliſh money.

4)100
— 25

£75 *Anſ.*

6. To Iriſh Money.

Rule.—Multiply the given ſum by 13, and divide the product by 16.

Reduce £100 New-Hampſhire, &c. to Iriſh money.

100

4×3+the given ſum.

400
3

1200
+100

16=4×4)1300

4)325

£81 5 *Anſ.*

7. To Canada and Nova Scotia currency.

Rule.—Multiply the given ſum by 5, and divide the product by 6.

Reduce £100 New-Hampſhire, &c. to Canada, &c.

100
5

6)500

£83 6 8 *Anſ.*

8. To Livres Tournois.

Rule.—Multiply the given pounds by $17\frac{1}{2}$, and the product will be Livres:—Or, multiply the ſum in ſhillings by 7; divide the product by 8, and the quotient will be livres, ſous, &c.

Reduce £100 New-Hampſhire, &c. to Livres Tournois.

100	Or,	100
$17\frac{1}{2}$		20
700		2000
100		7
50		
8)14000		
1750		

Anſ. 1750 Liv. *Anſ.* 1750 Liv.

1d.=1ſou.$5\frac{1}{2}$den. 1s.=$17\frac{1}{2}$ ſous. £1=$17\frac{1}{2}$ livres.

9. To Spaniſh milled Dollars.

Rule 1.—When the ſum conſiſts of pounds only, annex a cypher to the pounds, and divide the whole by 3; the quotient is dollars.

Reduce

Reduce £100 New-Hampſhire, &c. to Dollars.

3)1000

Dol. 333⅓ *Anſ.*

Rule 2.—When the ſum conſiſts of pounds and ſhillings:—Divide the pounds by 3, and the ſhillings by 6, not ſeparating them in the quotient, and the quotient will be dollars.

Reduce £152 15s. 6d. to dollars

£ by 3 & s. by 6. } 152 15/6.

509dol. and (15/6 *Anſ.*

Note. This article may be applied to the Federal dollar, it being of the ſame value with a Spaniſh dollar.

II. *To reduce Federal money to New-England and Virginia currency.*

Rule.—Multiply the Federal money by 3, and, if it conſiſt of dollars only, cut off 1 figure, if of cents alſo, cut off three, and if of mills, 4 figures at the right hand? then reduce the figures ſo cut off to farthings, each time cutting off as at firſt, and the left hand figures are pounds, ſhillings, &c.

1. Reduce 1166 dolls. 51c. 3m. to New England currency or lawful money.

D. c. m.
1166,51 3
3
£349,9539
20
s. 19,0780
12
,936=1d. (nearly.

2. Reduce 45 dollars.

D.
45
3
£13,5
20
s. 10,0

3. Reduce 12D. 7c. to lawful money.

D. c.
12,97
3
£3,621
20
s. 12,420
12
d. 5,040

III. *To*

III. *To reduce New-Jerſey, Pennſylvania, Delaware, and Maryland currency.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut, and Virginia currency.

Rule.—Deduct one fifth from the given ſum.

Reduce 100l. New-Jerſey, &c. to New Hampſhire, &c.

5)100
—20
80l. *Anſ.*

2. To New York and North-Carolina currency.

Rule.—Add one fifteenth to the given ſum.

Reduce 100l. New-Jerſey, &c to New York, &c.

15=3×5)100
3)20
+6 13 4+*giv.*
[*ſum.*
£106 13 4 *Anſ.*

3. To South Carolina and Georgia currency.

Rule.—Multiply the given ſum by 28, and divide the product by 45.

Reduce 100l. New Jerſey, &c. to South Carolina, &c.

100
4×7=28
400
7
45=5×9)2800
5)311 2 $2\frac{1}{3}$
Anſ. £62 4 $5\frac{1}{3}$

4. To Engliſh money.

Rule.—Multiply the given ſum by 3, and divide the product by 5.

Reduce 100l. New-Jerſey, &c. to Engliſh money.

100
3
5)300
£60

5. To Iriſh Money.

Rule. Multiply the New-Jerſey, &c. by 13, and divide the product by 20.

Reduce 100l. New-Jerſey, &c. to Iriſh.

100

4×3+the [giv.ſum.

400

3

1200

+100

20=4×5)1300

4)260

£65 *Anſ.*

6. To Canada and Nova-Scotia currency.

Rule.—Deduct one third from the New-Jerſey, &c.

Reduce 100l. New-Jerſey, &c to Canada, &c.

3)100

—33 6 8

£66 13 4 *Anſ.*

7. To Livres Tournois.

Rule.—Multiply the given ſum by 14, and the product will be Livres Tournois—or multiply the ſum in ſhillings by 7; divide the product by 10, and the quotient will be livres, ſous, &c.

Reduce 100l. New-Jerſey, &c. to Livres Tournois

100	Or 100	1d. = 1⅛ ſous.
14	20	1s = 14 ſous.
400	2000	1 = 14 liv.
100	7	
1400	10)14000	
Liv. *Anſ.*	1400 as before.	

8. To Spaniſh milled Dollars.

Rule.—Multiply the given ſum by 2⅔—or multiply them by 8; divide the product by 3. If there be ſhillings in the given ſum, for every 7s. 6d. add 1 dollar to the quotient.

Reduce 100l. 10s. New-Jerſey, &c. to Dollars.

100

8

3)800

266⅔

10s. = 1⅓

Anſ. 268 Dolls.

Or,

Or, 100
2
200
100X$\frac{2}{3}$= 66$\frac{2}{3}$
103.= 1$\frac{1}{3}$
268 as bef.

IV. *To reduce New-York and North Carolina currency.*

1. To New-Hampshire, Massachusetts, Rhode Island, Connecticut and Virginia currency.

Rule. Deduct one fourth from the New-York, &c.

Reduce 100l. New-York, &c. to New-Hampshire, &c.

4)100
—25
£75 *Ans.*

2. To New-Jersey, Pennsylvania, Delaware, and Maryland currency.

Rule. Deduct one sixteenth from the New-York, &c.

Reduce 100l. New-York, &c. to New-Jersey, &c.

16=4X4)100
4)25
—£6 5
Ans. £93 15

3. To South Carolina and Georgia currency.

Rule. Multiply the given sum by 7, and divide the product by 12.

Reduce 100l. New-York, &c. to South Carolina, &c.

100
7
12)700
£58 6 8 *Ans.*

4. To English Money.

Rule. Multiply the given sum by 9; divide the product by 16.

Reduce 100l. New-York, &c. to English money. 100
9
16=4X4)900
4)225
£56 5 *Ans.*

5. To Irish Money.

Rule. Multiply the given sum by 39; divide the product by 64.

Reduce

Reduce 100l. New-York, &c. to Iriſh money.

100

6 X 6 + thrice the given ſum.

600
6

3600
+300=100X3

64=8X8)3900

8)487 10

Anſ. £60 18 9

6. To Canada and Nova Scotia currency.

Rule. Multiply the given ſum by 5, and divide the product by 8.

Reduce 100l New-York, &c. to Canada, &c.

100
5

8)500

£62 10 *Anſ.*

7. To Livres Tournois.

Rule. Multiply the given ſum in ſhillings by 21; divide the product by 32, and the quotient will be livres, ſous, &c.

Reduce 100l. New-York, &c. to Livres Tournois.

100
20

2000
21

2000
4000

32=4X8)42000

4)5250

Anſ. 1312½ Liv.

Note. { 1d. = 1 3/8 Sous. / 1s. = 13 1/8 Sous. / £1 = 13 1/8 Liv.

8. To Spaniſh milled Dollars.

Rule. If the New-York ſum be pounds only, annex a cypher to them, then divide by 4, and the quotient is dollars: But if it be pounds and ſhillings, annex half the ſhillings to the pounds and divide as before, and the quotient is dollars.

Reduce 100l. New-York, &c. to dollars.

4)1000

250 dollars, *Anſ.*

Reduce

Reduce 100l. 8s. to Dollars.

4)1004

251 dollars, *Anſ.*

V. *To reduce South-Carolina and Georgia currency.*

1. To New-Hampſhire Maſſachuſetts, Rhode Iſland, Connecticut and Virginia currency.

Rule. Multiply the given ſum, by 9, and divide the product by 7.

Reduce 100l. South-Carolina, &c. to New-Hampſhire, &c.

100
9
7)900

£128 11 $5\frac{1}{7}$ *Anſ.*

2. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. Multiply the given ſum, by 45, and divide the product by 28.

Reduce 100l. South-Carolina, &c. to New-Jerſey, &c.

100
$9 \times 5 = 45$
900
5
$28 = 4 \times 7)4500$
4)642 17 $1\frac{4}{7}$

Anſ. £160 14 $3\frac{3}{7}$

3. To New-York and North-Carolina currency.

Rule. Multiply the given ſum by 12, and divide the product by 7.

Reduce 100l. South-Carolina, &c. to New-York, &c.

100
12
7)1200

£171 8 $6\frac{6}{7}$ *Anſ.*

4. To Engliſh Money.

Rule. From the given ſum deduct one twenty-eighth.

Reduce 100l. South-Carolina, &c. to Engliſh Money.

28=

28=4×7)100

4)14 5 $8\frac{4}{7}$

—3 11 $5\frac{1}{7}$ from the giv. sum.

£96 8 $6\frac{6}{7}$ *Ans.*

5. To Canada and Nova-Scotia currency

Rule. Multiply the given sum by 15, and divide the product by 14.

Reduce 100l. South-Carolina, &c. to Canada, &c.

100

5×3

500

3

14=2×7)1500

2)214 5 $8\frac{4}{7}$

£107 2 $10\frac{2}{7}$

6. To Livres Tournois.

Rule. Multiply the given pounds by $22\frac{1}{2}$, and the product will be livres.

Reduce 100l. South-Carolina, &c. to livres.

100

$22\frac{1}{2}$

200

200

50

Note.

1d.=$1\frac{7}{8}$ sous.

1s.=$1\frac{1}{8}$ liv.

£1=$22\frac{1}{2}$ liv.

Ans. 2250 livres.

7. To Irish Money.

Rule. Multiply the given sum by 117, and divide the product by 112.

Reduce 100l. South-Carolina, &c to Irish.

100

12×9+9 times the 9 given sum.

1200

1080

+100×9=900

112=4×4×7)11200

4)1671 8 $6\frac{6}{7}$

4)417 17 $1\frac{5}{7}$

Ans. £104 9 $3\frac{3}{7}$

8. To Spanish milled Dollars.

Rule. Multiply the given pounds by 30, and divide the product by 7, and if there be shillings, turn them into dollars, and add them.

Reduce 100l South-Carolina, &c. to dollars.

100

10×3=30

1000

3

7)3000

Dollars 428$\frac{4}{7}$ *Ans.*

Note, $\frac{1}{7}$=8d.

VI. To

VI. *To reduce Engliſh Money.*

To New Hampſhire Maſſachuſetts, Rhode-Iſland, Connecticut, and Virginia currency.

Rule. To the Engliſh ſum add one third.

Reduce 100l. Engliſh, to New-Hampſhire, &c.

3)100
+33 6 8

£133 6 8 *Anſ.*

2. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. Multiply the Engliſh money by 5, and divide the product by 3.

Reduce 100l. Engliſh to New-Jerſey, &c.

100
5

3)500

£166 13 4 *Anſ.*

3. To New York and North-Carolina currency.

Rule. Multiply the Engliſh money by 16, and divide the product by 9.

Reduce 100l. Engliſh to New-York, &c.

100

4×4

400
4

9)1600

£177 15 $6\frac{2}{3}$ *Anſ.*

4. To South-Carolina and Georgia currency.

Rule. To the Engliſh money add one twenty ſeventh.

Reduce 100l. Engliſh to South-Carolina, &c.

27=3×9)100

3)11 2 $2\frac{2}{3}$
+3 14 $0\frac{8}{9}$

Anſ. £103 14 $0\frac{8}{9}$

5. To Iriſh Money.

Rule. To the Engliſh ſum add one twelfth.

Reduce £100 Engliſh money to Iriſh money.

12)100
+8 6 8

£108 6 8 *Anſ.*

6. To Canada and Nova-Scotia currency.

Rule. To the Engliſh um add one ninth.

Reduce

Reduce £100 Engliſh to Canada, &c.

9)100
+11 2 $2\frac{2}{3}$

£111 2 $2\frac{2}{3}$ *Anſ.*

7. To Livres Tournois.

Rule. Multiply the Engliſh pounds by $23\frac{1}{3}$, and the product will be livres.

Reduce £100 Engliſh to Livres Tournois.

100		*Note.*
$23\frac{1}{3}$	1d. =	$1\frac{1}{18}$ ſous.
	1s. =	$1\frac{1}{6}$ liv.
300	£1 =	$23\frac{1}{3}$ liv.
200		
$33\frac{1}{3}$		

liv. ſou. de

$2333\frac{1}{3}$liv. = 2333 6 8 *Anſ.*

VII. *To reduce Iriſh money.*

1. To New Hampſhire, Maſſachuſetts, Rhode Iſland, Connecticut, and Virginia currency

Rule. Multiply the Iriſh ſum by 16, and divide the product by 13.

Reduce £100 Iriſh to New-Hampſhire, &c.

100
4×4
400
4
13)1600
£123 1 $6\frac{6}{13}$ *Anſ.*

2. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. Multiply the Iriſh ſum by 20, and divide the product by 13.

Reduce 100l. Iriſh to New-Jerſey, &c.

100
4×5=20
400
5
13)2000(153 16 11 $\frac{1}{13}$ Anſ.
13 11 12
70 20 12
65 13)220(16 13)144(11
50 13 13
59 90 14
78 13
11 12 1.

3. To Livres Tournois.

Rule. Multiply the Iriſh ſum in pence, by 70; divide that product by 39, and the quotient will be ſous, which divided by 20, will be livres.

Reduce 100l. Iriſh to Livres Tournois.

100×20×12=24000d.
70
2,0
29)1680000(430,6
ſou.

Anſ. Liv. 2153 $16\frac{12}{13}$
1d. is $1\frac{3}{39}$ſous. 1s. is $21\frac{7}{13}$ſ.
£1 is 21 livres, $10\frac{10}{13}$ ſous.

4. To

4. To Canada and Nova-Scotia currency.

Rule. To the Iriſh ſum add one thirty-ninth.

Reduce 100l. Iriſh to Canada, &c.

39)100(2
78
22
20

39)440(11
39
50
39
11
12

39)132(3
117
15 5
39 13

100
+2 11 $3\frac{5}{13}$

£102 11 $3\frac{5}{13}$ *Anſ.*

5. To South-Carolina and Georgia currency.

Rule. Multiply the Iriſh ſum, by 112, and divide the product by 117.

Reduce 100l. Iriſh to South-Carolina, &c.

100

7X4X4=112

700
4
2800
4

£
117)11200(95 14 $6\frac{42}{117}$
1053 *Anſ.*

670
585
85

6. To New-York and North-Carolina currency.

Rule. Multiply the Iriſh ſum by 64, and divide the product by 39.

Reduce £100 Iriſh to New-York, &c.

100

8X8=64

800
8

£ s.
39)6400(164 $2\frac{2}{39}$ *Anſ.*
39

250
234

160
156

4

7. To

7. To Engliſh money.

Rule. From the Iriſh ſum deduct one thirteenth.

Reduce 100l. Iriſh to Engliſh money.

13)100(7
91
9
20
13)180(13
13
50
39
11
12
13)132(10
13
2

£.	s.	d.	
100	0	0	
—7	13	11	$\frac{2}{13}$
92	6	1	$\frac{11}{13}$

Anſ.

VIII. *To reduce Canada and Nova Scotia currency.*

1. To New-Hampſhire, Maſſachuſetts Rhode-Iſland, Connecticut and Virginia currency.

Rule. To the given ſum add one fifth.

Reduce 100l. Canada, &c. to New-Hampſhire, &c.

5)100
+20
£120 *Anſ.*

2. To New-York and North-Carolina currency.

Rule. Multiply the given ſum by 8, and divide the product by 5.

Reduce 100l. Canada, &c. to New-York, &c.

100
8
5)800
£160 *Anſ.*

3. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. To the given ſum add one half.

Reduce 100l. Canada, &c. to New-Jerſey, &c.

2)100
+50
£150 *Anſ.*

4. To South-Carolina, and Georgia currency.

Rule. From the given ſum deduct one fifteenth.

Reduce 100l. Canada, &c. to South-Carolina, &c.

15=

15=3X5)100

3)20

—6 13 4

£93 6 8 *Anſ.*

5. To Engliſh Money.

Rule. From the given ſum deduct one tenth.

Reduce 100l. Canada, &c. to Engliſh money.

10)100

—10

£90 *Anſ.*

6. To Iriſh money.

Rule. From the given ſum deduct one fortieth.

Reduce 100l. Canada, &c. to Iriſh money.

40)100

—2 10

£97 10

7. To Livres Tournois.

Rule. Multiply the given pounds by 21, and the product will be Livres.

Reduce 100l. Canada, &c. to Livres Tournois.

100

7X3=21

700 1d = 1¾ Sous.
3 1s. =21 Sous.
1l. =21 Liv.
2100 *Anſ.*

8. To Federal or Spaniſh Dollars.

Rule. Reduce the given ſum to ſhillings: Divide them by 5. *Or*, multiply the pounds by 4, and if there be ſhillings, turn them into dollars and add them to the product.

Reduce 100l. Canada, &c. to dollars.

100 155 15
20 4

5)2000 620
+3=15s.
D. 400 *Anſ.*
Dol. 623 *Anſ.*

IX. *To reduce Livres Tournois.*

1. To New-Hampſhire, Maſſachuſetts Rhode-Iſland Connecticut and Virginia currency.

Rule. Multiply the Livres by 2; divide the product by 35, and the quotient will be pounds: Or, Multiply the Livres by 8:

Divide

Divide the product by 7, and the quotient will be shillings.

Reduce 1750 Livres to New-Hampshire, &c. currency.

1750 Or, 1750
2 8
£ —
35)3500(100 *A.* 7)14000
35 —
— 2,0)200,0
00 —
£100
(as before.

2. To New-York and North-Carolina currency.

Rule. Multiply the Livres by 32: Divide the product by 21, and the quotient will be shillings.

Reduce 1312½ Livres to New-York, &c. currency.

1312,5
32
26250
39375
2,0
2,1)42000(200,0
£100 *Anf.*

3. To New-Jersey, Pennsylvania, Delaware and Maryland currency.

Rule. Divide the Livres by 14, and the quotient will be pounds: Or, multiply the Livres by 10; Divide the product by 7, and the quotient will be shillings.

Reduce 1400 Livres to New-Jersey, &c. currency.

1400
10
Or, £
7)14000 14)1400(100
14
2,0)200,0 —
..00
£100 *Anf.*

4. To South-Carolina and Georgia currency.

Rule. Multiply the Livres by 2, divide the product by 45, and the quotient will be pounds. Or, deduct one ninth, and the remainder will be shillings.

Reduce 2250 Livres to South-Carolina, &c. currency.

2250 Or,
2 9)2250
£ —250
45)4500(100 *Anf.* —
45 2,0)200,0
— —
00 £100
(as before.

5. To English Money.

Rule. Deduct one seventh from the Livres, and the remainder

remainder will be shillings.

Reduce 2333⅓ Livres to Engliſh money.

7)2333⅓
—333⅓

2|0)200|0

£ 100 *Anſ.*

6. To Iriſh Money.

Rule. Reduce the livres to ſous, then multiply them by 39: Divide this product by 70, and the quotient will be pence.

Reduce 2153 liv. 16 12/13 ſous to Iriſh money.

liv. ſous.
2153 16 12/13
20

43076 12/13
39

387720
129228

7,0)168000,0

12)24000

2,0)200,0

£ 100 *Anſ.*

7. To Federal or Spaniſh Dollars.

Rule. Multiply the livres by 4; divide the product by 21, and the quotient will be Spaniſh or Federal Dollars.

Reduce 1000 Livres to Dollars.

1000
4

21)4000(190 *Fed. or Span Dol.*
21

190
189

10
10

d. c. m.
21)100(4 7 6 4/21

X. *To reduce Federal or Spaniſh Dollars.*

1. To New Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut and Virginia currency.

Rule. Multiply the Dollars by 3, and double the right hand figure of the product, for ſhillings; the left hand figures are pounds.

Reduce 529 Dollars to New Hampſhire, &c.

529
3

£ 158 14 *Anſ.*

2. To

2. To New York and North-Carolina currency.

Rule. Multiply the Dollars by 4; double the right hand figure of the product for shillings, and the left hand figures are pounds.

Reduce 529 dollars to New York, &c.

529
4

£211 12 *Anſ.*

3. To New-Jerſy, Pennſylvania Delaware and Maryland currency.

Rule. Multiply the Dollars by 3, and divide by 8.

Reduce 529 Dollars to New-Jerſey, &c.

529
3

8)1587(198 7 6 *Anſ.*
8
78
72
67
64
3

Or,

8)1587

£. 198 $\frac{3}{8}$ *Anſ.*

4. To South Carolina and Georgia currency.

Rule. Multiply the Dollars by 7, and divide by 30.

Reduce 529 Dollars to South Carolina, &c.

529
7

30)3703

£ 123 $\frac{13}{30}$

*5. To Engliſh Money, at 4s. 6d. per Dollar.

Rule. Multiply the Dollars by 9, and divide by 40.

Reduce 529 Dollars to Engliſh money.

529
9

40)4761

£ 119 $\frac{1}{40}$

6 To Canada and Nova-Scotia currency.

Rule. Divide the Dollars by 4.

Reduce 529 Dollars to Canada, &c.

4)529

£132 $\frac{1}{4}$ *Anſ.*

7. To Livres Tournois.

Rule. Multiply the Dollars

* *Note,* That in England Dollars are Bullion, that is they are bought and ſold by weight, and their value varies as other articles of merchandiſe.

dars by $5\frac{1}{4}$, and the product will be Livres: *Or*, Multiply them by 21, divide by 4, and the quotient will be Livres.

Reduce 100 Spaniſh Dollars to Livres.

		Or,
	100	100
	$5\frac{1}{4}$	21
	500	
$100+\frac{1}{4}=25$		4)2100
Anſ.	525 *liv.*	525 *as (before.*

NOTE,

1 Cent = $1\frac{1}{20}$ Sous.
1 Dime = $10\frac{1}{2}$ Sous.
1 Dollar = $5\frac{1}{4}$ Livres.

The pound Sterling, New-Hampſhire, &c., New-York, &c., New Jerſey &c., South-Carolina, &c. contains 1718⅔, 1289, 966¾, 1031¼, 1657,366 Grains of fine Silver.

Ditto, 1858
Ditto, $1393\frac{1}{2}$
Ditto, 1045
Ditto, $1114\frac{3}{4}$
Ditto, 1791,819
Grains of Stand. Silver.

The proportion of alloy being $\frac{1}{37}$ of the fine Silver.

The Federal Dollar Eagle contains 375,64 246,268 Grains of fine

Silver 409,78 grs. of Stand. Silver.
Gold 268,659 grs. of Stand. Gold.

The alloy being $\frac{1}{11}$ of the fine Silver. Gold.

The Subdiviſions are in the ſame proportion.

RECAPITULATION

RECAPITULATION *of the*

Seek the given Coin in the left hand column, then caſt required Coin, and you will have

		1	2	3	4	5
		New H. Maſ. R. I. Connect. Virginia.	New Jerſ. Pennſyl. Delaw. Maryl.	New Yor N. Carol.	S. Carol. Georgia.	Sterling.
1	New H. Maſ R. Conn / & Virg		Add $3\frac{1}{4}$ Page 118.	Add $\frac{1}{5}$ Page 118	Mult. by 75 divide Prod. by 1. P. 118	Deduct $\frac{1}{4}$ Page 118.
2	New J Pennſ Delaw. Maryl.	Deduct $\frac{1}{5}$ Page 121.		Add $\frac{1}{16}$ Page 121	Mult. by 28, divide Prod. by 45. P. 121.	Mult. by 3, divide Prod. by 5. P. 121.
3	New Y and N. Car.	Deduct $\frac{1}{4}$ Page 123.	Ded. $\frac{1}{16}$ Page 123.		Mult. by 7, & div. Prod. by 12, P. 123.	Mult. by 9, & div. Prod. by 16. P. 123.
4	S. Car. and Georg.	Mult. by 9. & div Prod. by 7 Page 125	Mult. by 45, & div Prod. by 28 P. 125	Mult. by 12, & div by 7. Page 125		Ded. $\frac{1}{28}$ Page 125.
5	Sterl.	Add $\frac{1}{3}$ Page 127	Mult. by 5. & div Prod. by 3 P. 127	Mult. by 16 & div. Prod. by 9. P. 127	Add $\frac{1}{27}$ Page 127.	
6	Iriſh.	Mult. by 6. & div. Prod. by 13. P. 128	Mult. by 20, & div by 13 Page 128	Mult. by 64, & div. by 39. Page 129	Mult. by 112 & div. by 117. Page 129.	Ded. $\frac{1}{13}$ Page 130
7	Canada and Nova-Scotia	Add $\frac{1}{5}$ Page 130	Add $\frac{1}{8}$ Page 130	Mult. by 8, and div Prod. by 5 page 130.	Ded. $\frac{1}{15}$ Page 129.	Ded. $\frac{1}{10}$ Page 131
8	Livres Tourn	Mult. by 2 div. by 35 or by 8, & d 7 & q. is.	Divide by 14. Page 132.	M. by 32, div. by 21, and quo. is ſhillings.	Deduct $\frac{1}{9}$ and rem. is ſhills. Page 132.	Deduct $\frac{5}{7}$ and rem. is ſhills. Page 132.
9	Fed'ral or Span Dollars	M 3 dou rt hd. pro. for s. left are poun.	Mult. by 3, & div. Prod by 8 Page 134.	M. 4, dou. rt. hd. Pro f. for s. left are poun.	Mult. by 7, & div Prod. by 30. P. 134.	Mult. by 4, & div. by 40. Page 134

preceding RULES *of* EXCHANGE.
your eye to the right hand, till you come under the the Rule with the Reference.

6	7	8	9
Iriſh.	Canada. Nova-Scot.	Livres Tournois.	Federal or Spaniſh Dollars.
Multip. by 13. div. by 16. Page 119.	Multiply by 5, div. by 6. Page 119.	Multiply by 17½ o, & di. by 3. Page 119.	If £'s. only annex a o, & di. by 3. If £'s & s. an. half s. & div. as bef. q isd re s. &c.
Multip. by 13, divide Prod. by 20. Page 121.	Deduct ⅓ Page 122.	Multiply by 14. Page 122.	Multiply by 2⅔. Page 122.
Multip. by 39, & div Prod. by 64 Page 123	Multiply by 5, & divide by 8. Page 124.	Multiply the ſum in ſhils. by 21, divide Product by 32. Page 124.	If £'s. only annex a o, and di. by 4. If £'s & s. an half the s. & div. as before. P. 124
Multip. by 117, & div. Prod. by 112 Page 126.	Multiply by 15, & div. by 14. Page 126.	Multiply pounds by 22½. Page 126.	Mult. pounds by 30, div. Prod. by 7, & if any s. turn them to dols. & add them.
Add 1/11 Page 127.	Add ⅒ Page 127.	Multiply pounds by 23⅓. Page 128.	Mult. by 40, divide Prod. by 9, & the rem. is ſix pences.
	Add 1/30 Page 129	Mult the ſum in pence by 70, div by 39, & quo. is s. which div. by 20.	M. by 160. di. pro. by 39, q. is dol. & unit in rem. is 1½d. Iriſh, or 2 cents nearly.
Deduct 1/40 Page 131.		Multiply by 21. Page 131.	Multiply by 4 Page 131.
Re. them to ſhil. M. by 39, div. by 70, & q. is d ſhillings.	Deduct 1/21 and the remainder is		Multiply by 4 & divide Product by 21. Page 133.
Div. by 4 & ded. 1/40 of the quotient.	Div. by 4 Page 134.	Multiply by 5¼ Page 134.	

The ſtandard Weight of an EAGLE 11 pwt. $4\frac{8}{9}$ grs —Half ditto, 5 pwt. $14\frac{4}{9}$ grs.—A DOLLAR 17 pwt. $1\frac{4}{9}$ grs.—Half ditto, 8 pwt. $12\frac{7}{9}$ grs.—A DOUBLE DIME 3 pwt. $9\frac{4}{9}$ grs.—A DIME 1 pwt. $16\frac{9}{10}$ grs.

TABLE *of the value of ſeveral Pieces of Coin, in the* FEDERAL COIN, *and the ſeveral Currencies of the* UNITED STATES.

	Federal Coin.	N. Hampſhire Maſſachuſetts, R. Iſland, Connecti. Virginia.	N. York and N. Carolina.	N. Jerſey, Pennſylvania, Delaware and Maryland.	South-Carolina and Georgia.
	Cents.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
$\frac{1}{10}$ of a Doll.	0,06$\frac{1}{4}$	4$\frac{1}{2}$	6	$\frac{4}{9}$	3$\frac{1}{2}$
$\frac{1}{4}$ a Piſtareen	0,10	7$\frac{1}{9}$	9$\frac{1}{9}$	9	5$\frac{2}{3}$
		Vir. 8			
$\frac{1}{9}$ of a Doll	0,11$\frac{1}{9}$	8	10$\frac{2}{3}$	10	6$\frac{2}{3}$
$\frac{1}{8}$ of ditto.	0,12$\frac{1}{2}$	9	1 0	11$\frac{1}{8}$	7
A Piſtareen	0,20	1 2$\frac{2}{9}$	1 4$\frac{1}{2}$	1 6	11
		Vir. 1 4			
Eng. Shill-	0,21$\frac{2}{9}$	1 4	1 7$\frac{2}{3}$	1 8	1 0$\frac{4}{9}$
$\frac{1}{4}$ of a Doll.	0,25	1 6	1 2 0	1 10$\frac{1}{2}$	1 2
Half ditto	0,50	3 0	4 0	3 9	2 4
A Dollar	1,00	6 0	8 0	7 6	4 8
Eng Crown	1,11$\frac{1}{9}$	6 8	*N.Y.* 9 0	8 4	5 2$\frac{2}{9}$
			N.C 8 9		
pwt. gr.					
Fr.G. 5 5	4,62$\frac{26}{27}$	1 7 6	1 16 0	1 14 6	1 1 5
In Maſſ 5 6	4,55$\frac{1}{9}$	1 7 4			
En.Gu 5 6	4,66$\frac{2}{3}$	1 8 0	1 17 0	1 15 0	1 1 9
In S.C 5 7					1 1 10
$\frac{1}{2}$ Joha. 9 0	8,00	2 8 0	3 4 0	3 0 0	1 17 4
Piſtole 4 5	)3,66$\frac{2}{3}$				
In Maſſ 4 3		1 2 0	1 8 0	1 7 0	17 6
Moid. 6 18	6,00	1 16 0	2 6 0	2 5 0	1 8 0
Doub 17 0	14,66$\frac{2}{3}$	4 8 0	5 16 0	5 12 0	3 10 0

CROSS MULTIPLICATION

Or,

DUODECIMALS

Is a rule made uſe of by Workmen and Artificers, in calling up the contents of their works

Dimenſions are generally taken in feet, inches, and parts.

Inches and parts are ſometimes called primes, ſeconds, thirds, &c. and are marked thus; inches or primes (′), ſeconds (″), thirds (‴), fourths (⁗), &c.

This method of multiplying is not confined to *twelves*; but may be greatly extended: For any number, whether its inferiour denominations decreaſe from the integer in the ſame ratio or not, may be multiplied croſſwiſe.

Rule 1.—Under the multiplicand write the correſponding denominations of the multiplier.

2. Multiply each term in the multiplicand, beginning at the loweſt, by the higheſt denomination in the multiplier, and write the reſult of each, under its reſpective term, obſerving in duodecimals, to carry a unit for every 12, from each lower denomination to its next ſuperiour and for other numbers accordingly.

3. In the ſame manner multiply all the multiplicand by the primes or ſecond denomination in the multiplier, and ſet the reſult of each term one place removed to the right hand of thoſe in the multiplicand.

4. Do the ſame with the ſeconds in the multiplier, ſetting the reſult of each term two places to the right hand of thoſe in the multiplicand.

5. Proceed in like manner with all the reſt of the denominations, and their ſum will be the anſwer required.

Examples.

EXAMPLES.

1. Multiply $2\frac{1}{2}$ feet by $2\frac{1}{2}$ feet.

F.	′			Or, thus.		Or, thus,
2	6			$2\frac{1}{2}$		2, 5
2	6			$2\frac{1}{2}$		2, 5
5	0			5		125
1	3	0		$1\frac{1}{4}$	*Anſ.*	50
6	3	*Anſ.*				6,25 Square Feet.

Anſ. $6\frac{1}{4}$ ſquare feet=6 feet, 36 inches. So that the 3 is not 3 inches, but 36 inches or $\frac{1}{4}$ of a ſquare foot.

2. Multiply 9f. 8′ 6″ by 7f. 9′ 3″.

f.	′	″			
9	8	6			
7	9	3			
67	11	6			= Product by the feet in the multiplier.
7	3	4	6‴		= ditto by the primes.
	2	5	1	6⁗	= ditto by the ſeconds.
75	5	3	7	6	*Anſ.*

3. How many ſquare feet in a board 17 feet 7 inches long, and 1 foot 5 inches wide?

Anſ. 24f. 10′ 11″

4. How many cubick feet in ſtick of timber 12 feet 10 inches long, 1 foot 7 inches wide, and 1 foot 9 inches thick?

Anſ. 35f. 6′ 8″ 6‴

The two following queſtions are Sexceſſimals.

5. If two places differ in longitude 2° 12′; what is their difference of time?

Mult. 2° 12′ 00″ 00‴
by 3′ 59″ 20‴ the time in which the Sun paſſes through one degree.

8′ 46″ 32‴ *Anſ.*

6. Two

6. Two places differ in longitude 31° 27′ 30″—what is the difference in time, of the Sun's coming to the meridian of thoſe places, the Sun paſſing through 15° in an hour?

31° 27′ 30″
4′ 00″ In 4′ of a ſolar day or a day of 24 hours, (the Sun paſſes 1 degree.
2 6′ 30″ 00‴ *Anſ.*

SINGLE RULE OF THREE DIRECT.

The Rule of Three Direct teacheth, by having three numbers given, to find a fourth, that ſhall have the ſame proportion to the third, as the ſecond hath to the firſt.

If *more* require *more*, or *leſs*, require *leſs*, the queſtion belongs to the Rule of Three Direct.

But if *more* require *leſs*, or *leſs* require *more*, it belongs to the Rule of Three Inverſe.*

Rule† 1.—State the queſtion by making that number, which aſks the queſtion, the third term, or putting it in the third place: That, which is of the ſame name or quality as the demand, the firſt term; and that which is

* *More* requiring *more*, is when the third term is greater than the firſt, and requires the fourth term to be greater than the ſecond. And *leſs* requiring *leſs*, is, when the third term is leſs than the firſt, and requires the fourth term to be leſs than the ſecond.

Alſo, *more* requiring *leſs*, is, when the third term is greater than the firſt, and requires the fourth term to be leſs than the ſecond. And *leſs* requiring *more*, is, when the third term is leſs than the firſt, and requires the fourth term to be greater than the ſecond.

† This Rule on account of its great and extenſive uſefulneſs is ſometimes called the *Golden Rule of Proportion*; for, on a proper application of it and the preceding rules, the whole buſineſs of Arithmetick, as well as every mathematical inquiry, depends. The rule itſelf is founded on this obvious principle, that the magnitude or quantity of any effect varies conſtantly in proportion to the varying part of the cauſe: Thus, the quantity of goods, bought, is in proportion to the money laid out;—the ſpace, gone over by a uniform motion, is in proportion to the time &c.

N

s. lb. s.
As 45 : 30 :: 9 : the *Anſ.*
9

45)270(6lb. *Anſ.*
270

Again 4. Suppoſe £2 5s. will buy 30lb. of ſugar: What will 6lb. of the ſame ſugar coſt?

lb. s. lb.
As 30 : 45 :: 6 : the *Anſ.*
6

30)270
9s.

N. B. The three laſt queſtions are only the firſt *varied*, being purely to ſhow how any queſtion in this rule may be inverted.

5. If 5yds. of cloth coſt £1 10s. what will 20yds. ditto come to?

£1 10s.
yds. s. yds. 20
As 5 : 30 :: 20 ——
30÷5=6 5)30s.
6 *Qus.*
2,0)12,0s=£6 *Anſ.*

Here I divide the 2d term by the 1ſt, and multiply the quotient into the 3d, for the anſwer.

yds. s. yds.
Again 6. As 5 : 30 :: 20
20÷5=4

120s.=£6.

Here, I divide the 3d term by the 1ſt, and multiply the quotient into the 2d for an anſwer.

7. If 20yds. coſt £120 how many yds. may I have for £30?

£. yds. £.
As 120 : 20 :: 30
120÷20=6 Quotient &
30÷ 6=5 yds. *Anſ.*

Here, I divide the 1ſt term by the 2d, and then the 3d term by that quotient for the anſwer.

Again, £. yds. £.
8. As 120 : 20 :: 30
120÷30=4 Quotient,
20÷ 4=5 yds. *Anſ.*

Here, I divide the 1ſt term by the 3d, and then the 2d term by that quotient for the anſwer.

9. If

denomination with the quotient contains of the next leſs, and divide this product again by the firſt number; and thus proceed, till the leaſt denomination be found, or till nothing remain.

5. If the firſt number be greater than the product of the ſecond and third; then bring the ſecond to a lower denomination.

6. When

9. If 1 *Cwt.* of tobacco coſt £5 12 9½; what will 8 *Cwt.* ditto coſt?

Cwt. £. s. d. Cwt.
As 1 : 5 12 9½ :: 8
8

Anſ. £45 2 4

Here is no need of reducing the middle term; becauſe it can be performed by compound multiplication, the firſt term being an unit.

10. If 8 *Cwt.* of tobacco coſt £45 2*s.* 4*d.* what is that *per Cwt.*?

£. s. d.
8)45 2 4

Anſ. £5 12 9½

Here, there is no need of reducing the middle term, becauſe it may be performed by compound diviſion only, the 3d term being an unit.

11. If 57*yds.* coſt £69, what will 9*yds.* coſt at that rate?

yds. £. *yds.*
As 57 : 69 : : 9
9

57)621(10£ Anſ.
57

51
20

57)1020(17*s.*
57

450
399

51
12

57)612(10*d.*
57

42
4

57)168(2$\frac{54}{57}$*qrs.*
114

Here, all the terms being whole numbers, there is no need of reducing the middle one till after ſtating.

12. If

6. When any number of barrels, bales, or other packages or pieces are given, each containing an equal quantity. let the contents of one be reduced to the loweſt name, and then multiplied by the given number of packages or pieces

7. If the given barrels, bales, pieces, &c. be of unequal contents, (as it moſt generally happens) put the ſeparate content of each properly under one another, then add them together, and you will have the whole quantity.

12. If 9*C.* 3*qr.* ſugar coſt 27*l.* 17*s.* 6*d.* what will 2*C.* 1*qr.* 11lb. coſt?

9C. 3qrs.	27l. 17s. 6d.	2C. 1qr. 11lb.
4	20	4
39	557	9
28	12	28
312	6690	73
78		19
1092		263

lb. d. lb.
As 1092 : 6690 : : 263 : *the Anſwer.*

263

2007
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1092)1759470(1611
1092

2|0)13|4 3d.
£6 14 3d. *Anſwer.*

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1227
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258
4

1092)1032(0*qr.*

Note 1. If you look at the ſtating, you will ſee that the firſt and third terms are of the ſame kind, but of different denominations, and therefore are reduced to the ſame name or denomination, and, that the demand of the queſtion lies on the third term.

2. That the middle term, being given in pounds, ſhillings and pence, is reduced to pence.

13. If my income be 109 guineas *per annum*, I deſire

desire to know what I may spend per day, so that I may lay up 45l. at the year's end?

Ans. £0 5 $10\frac{3}{4}$ $\frac{1}{365}$ *per day.*

Note 1. You must subtract 45l. from the value of 109 guineas.

2. There being 365 days in a year, your question must next be stated thus:

D. Guin. £. D. s. d. qr.

As 365 : 109 — 45 :: 1 : 5 10 3 $\frac{1}{365}$ *the Ans.*

14. If my salary be 43l. 12s. 5d. *per annum*, what does it amount to per week?

D. £. s. d. D.

As 365 : 43 12 5 :: 7 : 16s. $8\frac{3}{4}$d. *Ans.*

15. Suppose my income to be 16s. $8\frac{3}{4}$d. per week, what is it *per annum?* *Ans.* £43 12 5.

D. s. d. D.

As 7 : 16 $8\frac{1}{4}$ :: 365 : *the Answer, above.*

16. If I am to pay 1s 7d. per week for pasturing a cow; what must I give per week for 37 cows?

C. s. d. C. £. s. d.

As 1 : 1 7 :: 37 : 2 18 7 *Ans.*

17. How many yards of cloth may be bought for 57l. 13s. whereof $9\frac{1}{2}$ yards cost 3l 15s. $5\frac{1}{2}$d.?

£. s. d. Yds. £. s. Yds. qr. n,

As 3 15 $5\frac{1}{2}$: $9\frac{1}{2}$ :: 57 13 : 145 0 $2\frac{2}{36}\frac{0}{1}\frac{0}{2}\frac{4}{2}$ *Ans.*

18. If I buy 57 yards of cloth for 49 guineas: what did it cost per ell English?

Yds. Guin. Yds.

As 57 : 49 :: $1\frac{1}{4}$: £1 10s. $1\frac{1}{2}\frac{2}{2}\frac{9}{8}$d. *Ans.*

19. A merchant, failing in trade, owes in all 3475l, and has in money and effects but 2316l. 13s. 4d.: Now, supposing his effects are delivered up; pray, what will each creditor receive on the pound?

£. £. s. d. £.

As 3475 : 2316 13 4 :: 1 : 0l. 13s. 4d. *Ans.*

20. A owes B 3475l. but B compounds with him for 13s. 4d. on the pound; pray, what must he receive for his debt?

£. s. d. £. £. s. d.
As 1 : 13 4 :: 3475 : 2316 13 4 *Anſ.*

21. If the diſtance from Newburyport to York be 31 miles; I demand how many times a wheel, whoſe circumference is $15\frac{1}{2}$ feet, will turn round in performing the journey?

Feet. Cir. M. Cir.
As $15\frac{1}{2}$: 1 :: 31 : 10560 *times*, *Anſ.*

22. Bought 9 cheſts of tea, each weighing 3*C.* 2*qrs.* 21lb. at 4l. 9s. per Cwt.; what came they to?

Cwt. £. s. C. qr. lb. £. s. d.
As 1 : 4 9 :: 3 2 21×9 : 147 13 $8\frac{1}{4}$.

23. What will $37\frac{1}{2}$ groſs of buttons, at $9\frac{1}{2}$d. per dozen, come to?

Doz. d. Groſs. £. s. d.
As 1 : $9\frac{1}{2}$ :: $37\frac{1}{2}$: 17 16 3 *Anſ.*

24. A farm, containing 125*A.* 3*R.* 27*P.* is rented at 3l. 9s. per acre; what is the yearly rent of that farm?

A. £. s. A. R. P. £.
As 1 : 3 9 :: 125 3 27 : 434 $8/4\frac{1}{2}$ $\frac{144}{160}$ *Anſ.*

25. If a ſhip coſt 537l.; what are $\frac{3}{8}$ of her worth?

Eigh. £. Eigh. £. s. d.
As 8 : 537 :: 3 : 201 7 6 *Anſ.*

26. If $\frac{7}{16}$ of a ſhip coſt 349l.; what is the whole worth? *Sixt. £. Sixt. £. s. d.*
7 : 349 :: 16 : 791 14 $3\frac{1}{4}$ $\frac{1}{7}$ *Anſ.*

27. Bought a caſk of wine at 4/7 per gallon, for 125 dollars; how much did it contain?

s. d. Gal. Dol. Gal. qt. pt.
As 4 7 : 1 :: 125 : 163 2 $1\frac{1}{11}$ *Anſ.*

28. What comes the inſurance of 537l. 15s. to, at $4\frac{1}{2}$l. per centum?

£. £. £. s. £. s. d.
As 100 : $4\frac{1}{2}$ :: 537 15 : 24 3 $11\frac{1}{2}$ $\frac{4}{5}$ *Anſ.*

29. What comes the commiſſion of 785l. to, at $3\frac{1}{2}$ guineas per cent.?

£. Guin. £. £. s. d.
As 100 : $3\frac{1}{2}$ :: 785 : 38 9 $3\frac{1}{2}$ $\frac{2}{5}$ *Anſ.*

30. A

30. A merchant bought 9 packages of cloth, at 3 guineas for 7 yards; each package contained 8 parcels; each parcel, 12 pieces; and each piece, 20 yards; what came the whole to, and what per yard?

Yds. Guin. Pack. £.
As 7 : 3 :: 9 : 10368 *Anſ for the whole coſt.*
Yds. Guin. Yd.
As 7 : 3 :: 1 : £0 12s. *Anſwer per yard.*

31. A merchant bought 49 tons of wine for 273l.; freight coſt 27l.—duties 12—cellar 9l 10s. other charges 15l. and he would gain 55l. 10s by the bargain; what muſt I give him for 23 tons?

Tons £. £. £. £. s. £. £. s. Tons. £.
As 49 : 273+27+12+9 10+15+55 10 :: 23 : 184 Anſ.

32. If 100l. gain 6l. in a year, what will 475 gain in that time:

As £100 : £6 :: £475 : £28 10s. *Anſ.*

33. The earth being 360 degrees in circumference, turns round on its Axis in 24 hours; how far does it turn in one minute, in the 43d parallel of Latitude: The degree of Longitude in this Latitude being about 51 ſtatute miles?

H D M. M. Miles.
As 24 : 360 × 51 :: 1 : 12¼ *Anſ.*

34. Shipt for the Weſtindies 225 quintals of fiſh, at 15/6 per quintal; 37000 feet of boards, at 8½ dollars per 1000; 12000 ſhingles, at a half guinea per 1000; 19000 hoops at 1⅛ dollar per 1000, and 53 half joes; and, in return I have had 3000 gallons of rum, at 1s. 3d. per gallon; 2700 gallons of molaſſes, at 5½d. per gallon; 1500lb. of coffee, at 8½d. per lb. and 19 Cwt. of ſugar, at 12s. 3d. per Cwt. and my charges on the voyage were 37l. 12s. Pray, did I gain or loſe and how much, by the voyage.

Anſ loſt £134 9s. 9d.

35. If a ſtaff, 4 feet long, caſt a ſhade (on level ground) 7 feet; what is the height of that ſteeple

whoſe ſhade, at the ſame time, meaſures 198 feet?

F. Sh. ft. hei. F. Sh. ft. hei.

As 7 : 4 :: 198 : $113\frac{5}{7}$ *Anſ.*

36. *Suppoſe a tax of 755 be laid on a town, and the inventory of all the eſtates in the town amounts to 9345l. what muſt A pay, whoſe eſtate is 149l.?

£. £. £. £.

As 9345 : 755 :: 149 : 12 0 $9\frac{1095}{9345}$ *Anſ.*

37. If 50 gallons of water, in one hour, fall into a ciſtern, containing 230 gallons, and by a pipe in the ciſtern 35 gallons run out in an hour; in what time will it be filled?

Gal. Gal. H. Gal. H.

As 50—35 : 1 :: 230 : $15\frac{1}{3}$ *Anſ.*

38. A Butcher went with 416l. to buy cattle: Oxen at 22l. each, cows at 4l. ſteers at 3l. 10s. and calves at 2l. 10s. and of each a like number; how many of each could he purchaſe with that ſum?

£. £. £. s. £. s. each. £. each.

As 22+4+3 10+2 10 : 1 :: 416 : 13 *Anſ.*

39. Said Harry to Dick, my purſe and money are worth $3\frac{1}{4}$ guineas; but the money is worth eleven times

* It may not be amiſs to ſhew the general method of aſſeſſing town or pariſh taxes.

Firſt, then, an inventory of the value of all the eſtates, both real and perſonal, and the number of polls for which each perſon is rateable, muſt be taken in ſeparate columns: The moſt conciſe way is, then, to make the total value of the inventory the firſt term; the tax to be aſſeſſed, the ſecond; and 1l. the third, and the quotient will ſhew the value on the pound. 2dly—Make a table, by multiplying the value on the pound by 1, 2, 3, 4, &c.—3dly—From the inventory take the real and perſonal eſtates of each man, and find them ſeparately, in the table; which will ſhew you each man's proportional ſhare of the tax for real and perſonal eſtates.

Note. If any part of the tax is averaged on the polls, or otherwiſe, before ſtating, to find the value on the pound, you muſt deduct the ſum of the average tax from the whole ſum to be aſſeſſed for which average, you muſt have a ſeparate column, as well as for the real and perſonal eſtates.

EXAMPLE.

times as much as the purſe; pray how much money is there in it?

Guin. s. d.

As 12 . 1 :: $3\frac{1}{4}$: 7 7 *Then* 4l. 11s.—7/7=4l. 3/5 *Anſ.*

40. How many dozen pair of gloves, at 13 groats per pair, may I have for 125 dollars?

gr. pr. dol. doz. pr.

As 13 : 1 :: 225 : 14 $5\frac{4}{13}$ *Anſ.*

41. There is a ciſtern, having 4 cocks; the firſt will empty it in 10 minutes; the ſecond, in 20 minutes; the third, in 40, and the fourth, in 80 minutes: In what time will all four, running together, empty it?

Min. *Ciſt.*

As $\left\{\begin{matrix}10\\20\\40\\80\end{matrix}\right\}$ *Ciſt. Min.* : 1 :: 60 : $\left\{\begin{matrix}6\\3\\1\frac{1}{2}\\\frac{3}{4}\end{matrix}\right\}$ *Ciſt. Min. Ciſt. Min.*

As $11\frac{1}{4}$: 60 :: 1 : $5\frac{1}{3}$ *Anſ.*

$11\frac{1}{4}$ *Ciſt.*

42. A and B depart from the ſame place, and travel the ſame road; but A goes 5 days before B, at the rate of 20 miles per day; B follows at the rate of 25 miles per day; In what time and diſtance will he overtake A?

M. M. D. M. D. D.

As 25—20 : 1 :: 20 × 5 : 20

D. M. D. M.

Anſ. As 1 : 25 :: 20 : 500

43. If

EXAMPLE.

Suppoſe the General Court ſhould grant a tax of 100000l. of which the town of Newburyport is to pay 1321l. 17s. 6d. and of which the polls, being 750, are to pay 5s. 3d. each;—the town's inventory amounts to 45000l.; what will it be on the pound; and what is A's tax, whoſe eſtate (as by the inventory) is as follows, viz. real 376l. perſonal 149l. and he has 3 polls?

Pol. s. d. Pol. £. s. d.

Firſt, As 1 : 5 3 :: 750 : 196 17 6 the average part of the tax to be deducted from 1321l. 17s. 6d. and there will remain 1125l. *£. £. £.*

Secondly, As 45000 : 1125 :: 1 : 6d. on the pound.

TABLE

43. If the earth revolves 366 times in 365 days, in what time does it perform one revolution?

Rev. Days. Rev.

As 366 : 365 :: 1 : 23h. 56′ 3″ 56‴+=1 (Siderial day.*

44. If the earth makes one complete revolution in 23*h*. 56′ 3″+, in what time does it pass through one degree?

As 366° : 23*h* 56′ 3″ :: 1° : 3′ 59″ 20‴ *Anſ.*

45. If the earth performs its diurnal revolution in a Solar † day, or 24 hours; in what time does it move one degree?

As 360° : 24*h*. :: 1° : 4′ *Anſwer.*

46. Sold

TABLE.

£.	£. s. d.	£.	£. s. d.	£.	£. s. d.
1 is	— 0 6	20 is	0 10 —	200 is	5 — —
2 —	— 1 0	30 —	0 15 —	300 —	7 10 —
3 —	— 1 6	40 —	1 — —	400 —	10 — —
4 —	— 2 0	50 —	1 5 —	500 —	12 10 —
5 —	— 2 6	60 —	1 10 —	600 —	15 — —
6 —	— 3 0	70 —	1 15 —	700 —	17 10 —
7 —	— 3 6	80 —	2 — —	800 —	20 — —
8 —	— 4 0	90 —	2 5 —	900 —	22 10 —
9 —	— 4 6	100 —	2 10 —	1000 —	25 — —
10 —	— 5 0				

Now, to find what A's rate will be.

His real eſtate being 376*l*.; I find, by the table, that 300*l*. is £7 10*s*.
that 70*l*. is - - - - - 1 15
and that 6*l*. is - - - - - 3

Therefore, his real eſtate is £9 8

In like manner, I find the tax for perſonal eſtate to be 3 14 6*d*.

His 3 polls, at 5*s*. 3*d*. each, are 15 9

£13 18 3.

Real.			Perſonal.			Polls.			Total.		
£	s.	d.	£.	s.	d.	£.	s.	d	£	s	d
9	8	0	3	14	6	0	15	9	13	18	3

* A Siderial day is that ſpace of time which happens between the departure of a Star from, and its return to the ſame meridian again.

†The Solar day is that ſpace of time which intervenes between *the Sun's* departing from any one meridian to the ſame again

46. Sold a cargo of flax ſeed in Ireland, for 1795l. 10s. Iriſh money; what does that amount to in Maſſachuſetts currency, 81l. 5s. Iriſh being equal to 100l. Maſſachuſetts?

As $81\frac{1}{4}$l. : 100l. :: $1795\frac{1}{2}$: 2209l. 16s. 11d. *Anſ.*
Iriſh. Maſſ. Iriſh. Maſſ.

Or, As 13 : $1795\frac{1}{2}$l. :: 16 : 2209l. 16s. 11d. as before becauſe 13 Iriſh are equal to 16l. Maſſachuſetts.

47. My correſpondent in Maryland purchaſed a cargo of flour for me, for 437l. that currency; how much Maſſachuſetts money muſt I remit him, 125l. Maryland being equal to 100l. Maſſachuſetts?

As 125l. : 100l. :: 437l. : 349l. 12s. *Anſ.*

£. £. s. Becauſe 5l. Maryland are equal
Or, As 5 : 437 :: 4 : 349 12 to 4l. Maſſachuſetts.

48. A bill of exchange was accepted at Newburyport for the payment 345l. 10s. for the like value delivered in Newyork, at $133\frac{1}{3}$l. Newyork currency for 100l. Maſſachuſetts ditto; how much money was paid in Newyork, 75l. Maſſachuſetts being equal to 100l. of Newyork?

£ Maſſ. £. N. Y. £. Maſſ. £. N. Y.
As 75 : 100 :: 345 10 : 460 13 4 *Anſ.*

49. When the exchange from Maſſachuſetts to Georgia is $83\frac{1}{3}$l. Georgia per 100l. Maſſachuſetts, how much Maſſachuſetts money muſt be paid in Boſton to balance 457l. Georgia currency?

£. Geor. £. Maſſ. £. Geor. £. Maſſ.
As $83\frac{1}{3}$: 100 :: 457 : 548 8s. *Anſ.*

50. A merchant delivered at Boſton 320l. Maſſachuſetts currency, to receive 400l. in Philadelphia; what was the Maſſachuſetts pound valued at?

B. P. B. P.
As £320 : £400 :: £1 : £1 5s. *Anſ.*

£. £. £. £s. Becauſe 80l. Maſſachuſetts are
Or, As 80 : 100 :: 1 : 1 5 equal to 100l. Pennſylvania.

51. If

51. If I draw a bill of exchange for 537l. 10s. 6d. Maſſachuſetts, to be paid in Ireland, at 123$\frac{1}{13}$l. Maſſachuſetts, per 100l. Iriſh; for how much Iriſh money muſt I draw the bill?

Maſſ. *Iriſh.* *Maſſ* *Iriſh.*

As £123$\frac{1}{13}$: £100 :: £537 10/6 : £436 14/9$\frac{1}{4}$

£. £. £. £. { Becauſe 16l. Maſſ.

Or, as 16 : 537 10/6 :: 13 : 436 14/9$\frac{1}{4}$ { are=13l. Iriſh.

52. Suppoſe a bill is drawn in Ireland, and payable in Boſton, for 673l. 12s. 6d. Iriſh; how much Maſſachuſetts money comes it to, the exchange at 81$\frac{1}{4}$l. Iriſh per 100l. Maſſachuſetts?

£. £. £. £.

As 81$\frac{1}{4}$: 100 :: 673 12/6 : 829 1/6$\frac{6}{13}$

The value of any quantity of ſilver in any of the currencies of the United States, may be found by the following Proportion.

As the number of grains contained in 1l. is to 1l.; ſo are the grains, in any given quantity, to its value.

53. What is the value of 1lb. of ſilver in Maſſachuſetts currency; the pound (or 20 ſhillings) containing 1393$\frac{1}{2}$ grains?

As 1393$\frac{1}{2}$: 1 :: 5760 : 4 2/8.

RULE OF THREE DIRECT, IN VULGAR FRACTIONS.

RULE.* Having made the neceſſary preparations, as directed in multiplication and diviſion of vulgar fractions, ſtate your queſtion as in whole numbers, and invert the firſt term of the proportion; then multiply the three terms continually together, and the product will be the anſwer.

1. If

* This Rule and the next, depend upon the ſame principles as the Rule of Three in whole numbers.

1. If $\frac{5}{8}$ of a yard coſt $\frac{4}{7}$ of a £. what will $\frac{9}{15}$ of an ell Engliſh coſt ?

$\frac{5}{8}yd. = \frac{5}{8}$ of $\frac{4}{7}$ of $\frac{1}{3} = \frac{5 \times 4 \times 1}{8 \times 1 \times 5} = \frac{1}{2}$ ell Engliſh.

E. Eng. £ *E Eng.*
As $\frac{1}{2} : \frac{5}{7} :: \frac{9}{15}$ And $\frac{2}{1} \times \frac{4}{7} \times \frac{9}{15} = \frac{2 \times 5 \times 9}{1 \times 7 \times 15} = \frac{90}{105}$

$(= 17s.\ 1\frac{1}{7}d.\ \frac{6}{7}$ *Anſ.*

2. If $\frac{3}{5}$ yd. coſt $\frac{7}{8}$l. what will $40\frac{1}{2}$ yds. come to ?

Anſ. £59 18. 3d.

3. If 70 buſhels of corn coſt $12\frac{3}{7}$l. ; what is it per buſhel ? *Anſ.* 3s. $7\frac{1}{3}$d.

4. If $\frac{7}{16}$ of a ſhip coſt 51l. ; what are $\frac{1}{3}\frac{1}{2}$ of her worth ? *Anſ.* £10 18s. $6\frac{3}{4}$d. $\frac{3}{4}$.

5. At $3\frac{5}{8}$l. per Cwt. what will $9\frac{1}{3}$lb. come to ?

Anſ. 6s. 2d. $\frac{5}{16}$

6. A perſon having $\frac{4}{5}$ of a veſſel, ſells $\frac{2}{3}$ of his ſhare for 319l. ; what is the whole veſſel worth ?

Anſ. £598 2s. 6d.

7. A merchant ſold $5\frac{1}{2}$ pieces of cloth, each containing $12\frac{2}{3}$ yds. at 9s. $\frac{1}{2}$d. per yard ; what did the whole amount to ? *Anſ.* £31 9s. $10\frac{3}{4}$d. $\frac{1}{3}$.

8. A buys of B $560\frac{1}{4}$l. bank ſtock, at $85\frac{2}{3}$ per cent. what comes it to ? *Anſ.* £480 7s. $6\frac{1}{7}$d.

9. A merchant makes inſurance upon a veſſel and cargo, valued at 3750l. 16s. at $15\frac{1}{2}$ guineas per cent. what does the premium amount to ?

Anſ. £813 18s. $5\frac{1}{4}$d.

10. A merchant in Holland draws a bill upon his correſpondent in Boſton for 3750 Ducats at 8s. $4\frac{1}{3}$d. how much Maſſachuſetts currency muſt he receive ?

Anſ. £1565 12s. 6d.

11. A gentleman from Boſton being in England, where the price of ſilver is to that of gold, as 1 to $15\frac{1}{14}$, exchanged $158\frac{1}{4}$lb. of ſilver for gold ; on his return to Maſſachuſetts, where the price of ſilver is to that of gold, as 1 to $15\frac{15}{71}$; a friend, wanting his gold, gave him the value thereof in ſilver ; what weight of ſilver did he gain by the exchange ?

As

lb. *Sil.* *G.* lb. *Sil.* lb. *Gold.* *G.* *Sil.* *G.* lb *Sil.*
As $15\frac{1}{14} : \frac{1}{7} :: 158\frac{1}{4} : 10\frac{1}{2}$ As $\frac{1}{1} : 15\frac{15}{31} :: 10\frac{1}{2} : 162\frac{36}{62}$.
(*Anf.* $4\frac{41}{124}$lb.

12. A merchant bought a number of bales of velvet, each containing $129\frac{7}{27}$ yards at the rate of 7 dollars for 5 yards, and ſold them out at the rate of eleven dollars for ſeven yards; and gained 200 dollars by the bargain; how many bales were there?

Yds. Dol. Yds. Dol.
As 7 : 11 :: 5 : $7\frac{6}{7}$ { Sold 5 yards for $7\frac{6}{7}$ Dollars.
Bought 5 yards for 7 Dollars.
In 5 yards gain'd $\frac{6}{7}$ Dollar.

D. Yds. D. Yds. Yds. B. Yds. Bales.
As $\frac{6}{7} : 5 :: 200 : 1166\frac{2}{3}$. As $129\frac{7}{27} : \frac{1}{7} :: 1166\frac{2}{3} : 9A$.

Although the method before laid down be univerſally applicable, yet there are other methods more ready and expeditious in ſome particular caſes.

RULE 1.—If the firſt and third terms be fractions, and the ſecond a whole number, reduce the firſt and third to one common denominator; then, rejecting the denominators, make the numerator of the firſt, the firſt term, and the numerator of the third, the third term, and work as in whole numbers.

If $\frac{5}{8}$ yard coſt 9s. what coſt $\frac{7}{12}$ yard at that rate?
$\frac{5}{8} = \frac{15}{24}$ & $\frac{7}{12} = \frac{14}{24}$. Now, as 15 : 9s :: 14 : 8s. $4\frac{3}{4}$d *Anſ.*

RULE 2.—If, of the firſt and third terms, one be 1, and the other a fraction; put the denominator of the fraction inſtead of 1, and the numerator in the place of the fraction, and work as in whole numbers, as before.

If 1 acre of land coſt 12l.; what will $\frac{5}{8}$ of an acre coſt, at that rate?

Den. £. *Num.* £. s.
As 8 : 12 :: 5 : 7 10 *Anſ.*

RULE 3.—If the ſecond term be a fraction likewiſe, (that is, if all the terms be fractions;) having reduced the firſt and third to one common denominator, multiply the numerator of the firſt term by the denominator of the ſecond, for a diviſor;—and the numerator or the third by the

the numerator of the ſecond, for a dividend; divide the laſt product by the firſt, and the quotient will be the anſwer.

If $\frac{1}{2}$ yard of cloth coſt £$\frac{3}{4}$ what coſt $\frac{1}{8}$ yard?

$\frac{1}{2}=\frac{4}{8}$, which reduces it to a common denominator, then

As 4 : $\frac{3}{4}$ :: 7

4 3

16 16)21(1$\frac{5}{16}$=26s. 3d. *Anſ.*

16

5

PROBLEM 1. *To find the value of Gold in Maſſachuſetts currency.*

oz. £. oz. £. pwt. s. gr. d.

THEOREM 1. As 1 : $5\frac{1}{3}$ :: 12 : 64 :: 1 : $5\frac{1}{3}$ :: 1 : $2\frac{2}{3}$ (Caſe 1.)=$\frac{2\frac{2}{3}}{1}$ (Caſe 2.)=$\frac{5\frac{1}{3}}{2}$ (Caſe 3.)=$\frac{8}{3}$: therefore,

RULE 1. *If the given quantity be in grains;* multiply them by $2\frac{2}{3}$, and the product is pence.

1. What is the value of 18 grains of gold?

$18\times 2\frac{2}{3}=48d=4s.$

RULE 2. *If the given quantity conſiſts of ounces pennyweights and grains,* halve the grains, and then proceed as in multiplication of pounds, ſhillings and pence, making the numerator in Caſe 2, the multiplier.

1. What is the value of 7oz. 8pwt. 16gr. of gold?

gr. gr. oz. pwt. gr.

16÷2=8, then 7 8 8

5

37 3 4

2 9 $6\frac{2}{3}$

£39 12 $10\frac{2}{3}$ *Anſ.*

RULE 3. *If the given quantity conſiſts of pounds only;* multiply by 64, and the product will be the anſwer; but

if it conſiſts of pounds, ounces, &c. it will be moſt convenient to reduce the pounds to ounces, and proceed by Rule 2.

What is the value of 36lb. of gold, at 64l. per lb ?

$36 \times 64 = 2304$l. *Anſ.*

PROB. 2. *To aſcertain the value of any given quantity of gold in Spaniſh milled Dollars.*

THEOREM 2. 1 pwt. of gold $= 5\frac{1}{3}$s. 1 dol. $= 6$s.

And $\frac{5\frac{1}{3}}{6} = \frac{16}{18} = \frac{8}{9}$, therefore,

RULE. Reduce the given quantity of gold to pennyweights ; then, as the denominator is to the given quantity, ſo is the numerator to the anſwer in dollars.

Or,

Divide by the denominator, and multiply the quotient by the numerator.

Or,

Divide by the denominator, and ſubtract the quotient from the dividend ; in either caſe you will have the anſwer.

1. What is the value of 6oz. 6pwt. of gold, in Spaniſh dollars ?

6oz. 6pwt.

20

pwt. 126 pwt.

As 9 : 126 :: 8

8	Or,	Or,
9)1008	9)126	9)126
	14 × 8 = 112 *Anſ.*	Subt. 14
Anſ. 112 dollars.		112 *Anſ.*

PROB. 3. *To aſcertain the weight of gold equivalent to any given ſum currency.*

RULE 1. *If the given ſum be in pence reverſe* Rule 1, Theor. 1, that is ; as the numerator 8 is to the given ſum in pence ; ſo is the denominator 3 to the weight required in grains.

What

What weight of gold is equal to 4s. ?

d. 12
As 8 : 48 :: 3 —
3 48d.

8)144

Anſ. 18 grains.

RULE 2. *If the given ſum be in pounds, ſhillings and pence*; as $5\frac{1}{3}$ is equal to $\frac{16}{3}$; therefore divide the given ſum by 8, and that quotient by 2; add the two quotients together, double the laſt denomination, and you will have the anſwer.

What quantity of gold is equivalent to 45l. 13s. 4d. ?

oz. pwt. gr.
Mark the pounds, ſhillings and pence, as oz. pwt. & gr. } 8)45 13 4
2)5 14 2 } Add.
2 17 1 }
8 11 3+3
oz. 8 11 6 *Anſ.*

PROB. 4. *To find the weight of gold equivalent to any given number of dollars.*

RULE. Divide the dollars by the numerator 8, add the quotient to the dividend, and the ſum is pennyweights.

Required the weight of gold equal to 76 dollars ?

$76 \div 8 = 9\frac{1}{2}$ and $76 + 9\frac{1}{2} = 85\frac{1}{2}$pwt. *Anſ.*

RULE OF THREE DIRECT IN DECIMALS.

RULE. Having reduced your fractions to decimals, and ſtated your queſtion as in whole numbers, multiply the ſecond and third together; divide by the firſt, and the quotient will be the anſwer.

1. If $\frac{4}{5}$ of a yard coſt $1\frac{7}{12}$ of a pound ; what will $9\frac{2}{3}$ yards come to ?

$\frac{4}{5}$=,625, $1\frac{7}{12}$=,583+ and $\frac{2}{3}$=,666+

Yd. £. Yd.

As ,625 : ,583 :: 9,666

,583

28998
77328
48330

,625)5,635278(9,0164+=9l. 0s. $3\frac{3}{4}$d. *Anſ.*

2. If 1oz. of ſilver coſt 6s. 8d. what is the price of a bowl, which weighs 1lb 7oz. 13gr. ?

Anſ. 6l. 6s. 10d.

3. If $9\frac{1}{4}$ yards coſt 3l. 7s. 6d. what will $\frac{1}{2}$ a yard come to ? *Anſ.* 3s. $5\frac{1}{2}$d.

4. There is a ciſtern which has 3 cocks, the firſt will empty it in $\frac{1}{4}$ of an hour, the ſecond in $\frac{3}{4}$, and the third in $1\frac{1}{2}$ hour ; in what time will it be emptied, if all three run together ?

h. Ciſt. h. Ciſt. Ciſt. h. Ciſt.

As { ,25 : 1 :: 1 : 4 } As 6 : 1 :: 1 : ,1666+=
{ ,75 : 1 :: 1 : 1,333+ } (10 min. *Anſ.*
{ 1,5 : 1 :: 1 : 0,666+ }

6 ciſtern.

5. A conduit has a cock, which, running into a ciſtern, will fill it in 12 minutes : This ciſtern has 3 cocks ; the firſt will empty it in $\frac{1}{4}$ hour, the ſecond in $37\frac{1}{2}$ minutes, and the third in $\frac{1}{2}$ an hour ; in what time will the ciſtern be filled, if all four run together ?

h. Ciſt. h Ciſt.

As { ,2 : 1 :: 1 : 5 the filling cock. } 5 Ciſt filled in an hour.
{ 1,25 : 1 :: 1 : 0 8 } { 4,4 do. emptied do.
{ ,625 : 1 :: 1 : 1,6 } emptying do. { 6 ciſtern difference.
{ ,5 : 1 :: 1 : 2 }

44

Then

Cift. h. Cift. h. h. m.
Then, as ,6 : 1 :: 1 : 1,66+=1 40 *Anſ.*

The following queſtions are in the Coin of the United States.

6. If 19 yards coſt 25dol. 7d. 5c. ; what will 435$\frac{1}{2}$ yards come to ?

Yds. dol. d. c. Yds.
As 19 : 25 ,7 5 :: 435,5
25,75

21775
30485
21775
8710

D. d. c. m.
19)11214,125(590,2 1 7$\frac{2}{19}$ *Anſ.*

7. If 345 yards of tape coſt 5 dol. 1d. 7c. 5m. ; what will one yard coſt ?

Yds. D. d. c. m. Yds.
As 345 : 5, 1 7 5 :: 1
1

d. c. m.
345)5, 1 7 5(,0 1 5.
3 4 5

1 7 2 5
1 7 2 5

8. If I give 12 dol. 8d. 2c. 5m. for 675 tops ; how many tops will 19 mills buy ?

D. d. c. m. T. d. c. m.
As 12, 8 2 5 : 675 :: ,0 1 9
,019

6075
675

12,825)12825(1 top, Anſ.
12825

RECIPROCAL PROPORTION,

OR,

RULE OF THREE INVERSE,

Teaches, by having three numbers given to find a fourth, which ſhall have the ſame proportion to the ſecond, as the firſt has to the third.

Therefore, the greater the third term is, in reſpect to the firſt, the leſs will the fourth term be in reſpect to the ſecond; or, the leſs the third term is in proportion to the firſt, the greater the fourth muſt be in proportion to the ſecond; and this is called reciprocal, inverted or indirect proportion.

The principal difficulty, that will embarraſs the learner, will be, to diſtinguiſh when the proportion is direct, and when indirect.—This is done by an attentive conſideration of the ſenſe and tenor of the queſtion propoſed: For if thereby it appears, that when the third term of the ſtating is leſs than the firſt, the anſwer muſt be leſs than the ſecond; or when the third is greater than the firſt, the anſwer muſt be greater than the ſecond; then the proportion is direct: But, if the third be leſs than the firſt, and yet the ſenſe of the queſtion requires the fourth to be greater than the ſecond; or if the third being greater than the firſt the anſwer muſt be leſs than the ſecond, the proportion is inverſe.

RULE. *State and reduce the terms as in the Rule of Three Direct; then, multiply the firſt and ſecond terms

* If 4 men can do a piece of work in 12 days; in what time will 8 men do it?

As 4 men : 12 days :: 8 men : $\frac{4\times 12}{8}=6$ days the anſwer.

And here the product of the firſt and ſecond terms, that is, 4 times 12, or 48 is evidently the time in which one man would perform the work; therefore, 8 men will do it in one *eighth part* of the time, or 6 days.

terms together, and divide the product by the third; the quotient will be the answer, in the same denomination as the middle term was reduced into.

If there be fractions in your question, they must be stated as before directed; and if they be vulgar, invert the third term: Then multiply the three terms continually together, and the product will be the answer.

Examples.

1. How much shalloon, that is $\frac{4}{4}$ yard wide, will line $6\frac{3}{4}$ yards of cloth, which is $1\frac{1}{4}$ yard wide?

Yd.	yds.	qr.		qrs.	qrs.	qrs.
As $1\frac{1}{4}$	: $6\frac{3}{4}$	:: 3	As	5	: 27	:: 3
4	4				5	
5	27				5)135	
					4)45	
					$11\frac{1}{4}$ yds.	

Anſ.

The ſame by Vulgar Fractions.

Firſt. $1\frac{1}{4}=\frac{5}{4}$, $6\frac{3}{4}=\frac{27}{4}$, and 3qrs $=\frac{3}{4}$, then

yds. yds. yd.

As $\frac{5}{4}$: $\frac{27}{4}$ :: $\frac{3}{4}$ And $\frac{4}{5}\times\frac{27}{4}\times\frac{4}{3}=\frac{5\times27\times4}{4\times4\times3}=\frac{540}{48}=$

$\frac{45}{4}=11\frac{1}{4}$ yds. *Anſ.*

The ſame by Decimal Fractions.

$1\frac{1}{4}=1,25$, $6\frac{3}{4}=6,75$, and 3qrs.$=,75$, then

yd. yds. yd.

As 1,25 : 6,75 :: ,75

1,25

3375

1350

675

,75)8,4375(11,25 yds. *Anſ.*

2. What length of board $7\frac{1}{2}$ inches wide, will make a ſquare foot?

In. br. In. len. In br. In len.

As 12 : 12 :: $7\frac{1}{2}$: $19\frac{1}{5}$ *Anſ.*

3. How

3. How many yards of carpet, $2\frac{1}{4}$ feet wide, will cover a floor which is 18 feet long, and 16 feet wide?

ft. ft. ft. ft. yds.
As 16 :: 18 :: $2\frac{1}{4} \times 3$: $34\frac{10}{11}$ *Anſ.*

☞ Note, I multiply $2\frac{1}{4}$ by 3, becauſe 3 feet = 1 yd.

4. Suppoſe I lend a friend 350l. for 5 months, he promiſing the like kindneſs; but when requeſted, can ſpare but 125l.; how long may I keep it to balance the favour?

£. Mo. £. Mo.
As 350 : 5 :: 125 : 14 *Anſ.*

5. Suppoſe 450 men are in a garriſon, and their proviſions are calculated to laſt but 5 months; how many muſt leave the garriſon, that the ſame proviſions may be ſufficient for thoſe who remain, 9 months?

Mo. Men. Mo. Men. Men.
As 5 : 450 :: 9 : 250, & 450—250 = 200 Men *Anſ.*

6. If a man performs a journey in 15 days when the day is 12 hours long; in how many will he do it, when the day is but 10 hours?

h. d. h. d.
As 12 : 15 :: 10 : 18 *Anſ.*

7. If a piece of land, 40 rods in length, and 4 in breadth, make an acre; how wide muſt it be, when it is but 19 rods long, to make an acre?

Leng. Br. Leng. Br. ft. in.
As 40 : 4 :: 19 : 8 6 $11\frac{7}{19}$ *Anſ.*

8. If when wheat is 6s. per buſhel, the two-penny loaf weighs 9,6oz. what ought it to weigh, when wheat is 7s. 6d. per buſhel?

s. oz. s. d. oz. pwt. gr.
As 6 : 9,6 :: 7 6 : 7 13 14,4 Anſ.

9. If a piece of board be 30 inches in length; what breadth will make $1\frac{1}{2}$ ſquare foot?

ſq. f. in. in. in.
As 1,5 : 1 :: 30 : 7,2 Anſ.

10. If

10. If 9 men can build a houſe in 5 months, by working 14 hours per day; in what time will the ſame number of men do it, when they work only 10 hours per day?

h. mo. h. mo.
As 14 : 5 :: 10 : 7 *Anſ.*

11. A wall which was to be built 24 feet high, was raiſed 8 feet by 6 men, in 12 days; how many men muſt be employed to finiſh the wall in 4 days?

ft. men. ft. men.
As 8 : 6 :: 24—8 : 12 to finiſh it in 12 days. And

days. men. days. men.
As 12 : 12 :: 4 : 36 to finiſh it in 4 days.

12. There is a ciſtern having a pipe which will empty it in 6 hours; how many pipes of the ſame capacity will empty it in 20 minutes?

ho. pi. min. pi.
As 6 : 1 :: 20 : 18 *Anſ.*

13 What number of men muſt be employed, to finiſh in 9 days, what 15 men would be 30 days about?

da. men. da. men.
As 30 : 15 :: 9 : 50 *Anſ.*

14. If a field will feed 6 cows 91 days; how long will it feed 21 cows?

cows. d. cows. d.
As 6 : 91 :: 21 : 26 *Anſ.*

15. How much in length, that is $8\frac{1}{7}$ inches broad, will make a foot ſquare?

in. in. in. in.
As $\frac{144}{1}$: $\frac{1}{7}$ :: $8\frac{1}{7}$: $16\frac{32}{81}$ *Anſ.*

16. How much in length, that is $13\frac{7}{8}$ poles in breadth, will make a ſquare acre?

po. po. po. po.
As $\frac{160}{1}$: $\frac{1}{7}$ :: $13\frac{7}{8}$: $11\frac{59}{111}$ *Anſ.*

17. A

17. A regiment of ſoldiers, conſiſting of 745 men, is to be clothed, each ſuit to contain $3\frac{1}{2}$ yards of cloth which is $1\frac{3}{4}$ yard wide, and lined with ſhalloon $\frac{7}{8}$ yard wide; how many yards of ſhalloon will line them?

As $745 \times 3\frac{1}{2} : 1\frac{3}{4} :: \frac{7}{8} : 4097\frac{1}{2}$ yds. *Anſ.*

18. If a ſuit of clothes can be made of $4\frac{1}{8}$ yards of cloth, $1\frac{3}{4}$ yard wide; how many yards of coating, $\frac{7}{8}$ of a yard wide, will it require for the ſame perſon?

	yd.	yds.	yd.	yds.	qr.	n.
As $1\frac{3}{4}$: $4\frac{1}{8}$ :: $\frac{7}{8}$:	6		1		$3\frac{5}{7}$	Anſ.

ABBREVIATIONS.

To know whether a fraction, when abbreviated, be equivalent in all reſpects to the original given fraction.

RULE. As the numerator of the fraction, in its loweſt terms, is to its denominator; ſo will the numerator of the original fraction be to its own denominator.

Or, as one numerator is to the other; ſo will one denominator be to the other, &c.

A owes B 75l. 13s. 6d. now 1col. of A's money is equal to 140l. of B's; what muſt A pay to ſatisfy the ſaid debt?

$\frac{100}{140} = \frac{5}{7}$ therefore,

£.	s.	d.
75	13	6
		5
7)378	7	6
£54	1	$0\frac{6}{7}$ Anſ.

Now, to prove whether $\frac{5}{7}$ be equal to $\frac{100}{140}$.

Num. Den. Num. Den. Num. Den. Den.

As 5 : 7 :: 100 : 140—Or, as 5 : 100 :: 7 : 140

COMPOUND

COMPOUND PROPORTION,

OR,

DOUBLE RULE OF THREE,

Teaches to reſolve ſuch queſtions as require two or more ſtatings, by ſimple proportion; and that, whether direct or inverſe: It is compoſed (commonly) of 5 numbers to find a fixth, which if the proportion be direct, muſt bear ſuch proportion to the 4th and 5th, as the 3d bears to the 1ſt and 2d; but if inverſe the 6th number muſt bear ſuch proportion to the 4th and 5th, as the 1ſt bears to the 2d and 3d.

Always place the three conditional terms in this order; That number which is the principal cauſe of gain, loſs, or action, poſſeſſes the firſt place; that which denotes the ſpace of time, or diſtance of place, the ſecond; and that, which is the gain, loſs or action, the third; this being done, place the other two terms, which move the queſtion, under thoſe of the ſame name, and if the blank place or term ſought, fall under the third place, then the queſtion is in direct proportion; therefore,

RULE 1. Multiply the three laſt terms together, for a dividend, and the two firſt for a diviſor:—But if the blank fall under the firſt or ſecond place; then, the proportion is inverſe; therefore,

RULE 2. Multiply the firſt, ſecond and laſt terms together for a dividend, and the other two for a diviſor, and the quotient will be the anſwer.

EXAMPLES.

1. If 100l. gain 6l. in a year; what will 400l. gain in 9 months?

£. P. Mo. £. Int.

100 : 12 :: 6 Terms in the ſuppoſition, or conditional terms.

400 : 9 Terms which move the queſtion.

Here the blank falling under the third place, the queſtion is in direct proportion, and the anſwer muſt be found by the firſt rule; therefore,

400

400 × 9 × 6 = 21600 For the dividend, and
100 × 12 = 1200 For the divisor.

See the work at large.

£. Pr. Mo. £. Int.
100 : 12 :: 6
400 : 9

9

100 3600
12 6

12,00)216,00(

12,00)216,00(18£. Anſ.
12
—
96
96
—

2. If 100l. will gain 6l. in a year; in what time will 400l. gain. 18l.?

100 : 12 :: 6 Terms in the ſuppoſition.
400 : :: 18 Terms which move the queſtion.

Here the blank falling under the 2d place, the queſtion is in reciprocal or inverſe proportion, and the anſwer muſt be ſought by the ſecond Rule: Therefore,

100 × 12 × 18 = 21600 For the dividend.
400 × 6 = 2400 For the diviſor.

£. Pr. mo. £. Int.
100 : 12 :: 6
400 : :: 18

6

12

2400

216
100

2400)21600(9 months, Anſ.
216

3. If 400l. gain 18l. in 9 months; what is the rate per cent. per annum?

Pr.

Pr. mo. Int.
400 : 9 :: 18
100 : 12
18

96
12

400 216
9 100

3600) 21600(6l. *Anſ.*
216

4. What principal, at 6 per cent. per ann. will gain 18l. in 9 months?

Pr. mo. Int.
100 : 12 :: 6
9 :: 18
12

9 216
6 100

54)21600(400l. *Anſ.*
216

00

5. If 8 men ſpend 32l. in 13 weeks; what will 24 men ſpend in 52 weeks?

M. W. £.
8 : 13 :: 32
24 : 52 384l. *Anſ.*

6. If the freight of 9 hhds. of ſugar, each weighing 12 Cwt. 20 leagues, coſt 16l.; what muſt be paid for the freight of 50 tierces ditto, each weighing 2½ Cwt. 100 leagues?

hhds. leag. £.
9 : 20 : 16
50 : 100 £92 11 10⅔ *Anſ.*

7. There was a certain edifice completed in a year by 20 workmen; but the ſame being demoliſhed, it is neceſſary that juſt ſuch another ſhould be built in 5 months; I demand the number of men to be employed about it?

Men. mo. Ed.
20 : 12 :: 1
5 :: 1 48 men, *Anſ.*

8. If 6 men build a wall 20 feet long, 6 feet high and 4 feet thick, in 16 days; in what time will 24 men build one 200 feet long, 8 feet high, and 6 feet thick?

Men. da. ft.
6 : 16 :: $\frac{20 \times 6 \times 4}{}$
24 : :: $\frac{200 \times 8 \times 6}{}$ 80 days, *Anſ.*

COMPARISON OF WEIGHTS AND MEASURES.

Examples.

1. If 78 pence Maſſachuſetts be worth 1 French crown; how many Maſſachuſetts pence are worth 320 French crowns?

Fr. Cr. d. Fr C.
As 1 : 78 :: 320 : 24960d. *Anſ.*

2. If 24 yards at Boſton make 16 ells at Paris, how many ells at Paris will make 128 yards at Boſton?

Boſt. Par. Boſt. Par.
As 24yds. : 16ells. :: 128yds. : 85⅓ells, *Anſ.*

3. If 60lb. at Boſton make 56lb. at Amſterdam; how many lb at Boſton will be equal to 350 at Amſterdam?

Amſ. Boſt. Amſ. Boſt.
lb. lb. lb. lb.
As 56 : 60 :: 350 : 375 *Anſ.*

CONJOINED

CONJOINED PROPORTION

Is when the coins, weights or meaſures of ſeveral countries are compared in the ſame queſtion; or, in other words, it is joining many proportions together, and by the relation, which ſeveral antecedents have to their conſequents, the proportion between the firſt antecedent and the laſt conſeqnent is diſcovered, as well as the proportion between the others in their ſeveral reſpects.

This Rule may generally be ſo abridged by cancelling equal quantities on both ſides, and abrieviating commenſurables, that the whole operation may be performed with very little trouble—and it may be proved by as many ſtatings in the Single Rule of Three as the nature of the queſtion may require.

CASE I.

When it is required to find how many of the firſt ſort of coin, weight, or meaſure, menioned in the queſtion, are equal to a given quantity of the laſt.

Rule. Place the numbers alternately, that is, the antecedents at the left hand, and the conſequents at the right, and let the laſt number ſtand on the left hand; then multiply the left hand column continually for a dividend, and the right hand for a diviſor, and the quotient will be the anſwer.

Examples.

1. Suppoſe 100 yards of America=100 yards of England, and 100 yards of England=50 canes of Thouloufe, and 100 canes of Thouloufe=160 ells of Geneva, and 100 ells of Geneva=200 ells of Hamburgh; how many yards of America are equal to 379 ells of Hamburgh?

Antecedents.

Antecedents.	Conſequents.	Abridged. Ant.	Con.
100 of America	= 100 of England.		
100 of England	= 50 of Thouloufe.	5	8
100 of Thouloufe	= 160 of Geneva.	379	
100 of Geneva	= 200 of Hamburgh.		
379 of Hamburgh ?	Therefore,		

$\frac{379 \times 5}{8} = 236\frac{7}{8}$yds. of America = 379 ells of Hamburgh.

ILLUSTRATION.

The two 100's on both ſides cancel each other: Let the laſt cyphers of the three next antecedents and conſequents be cancelled, which is dividing by 10; then divide the ſecond antecedent and conſequent by 5, and the quotients will be 2 on the ſide of the antecedents, and 1 on the ſide of the conſequents; then 2 will meaſure the third antecedent and conſequent, and the quotients will be 5 and 8.—10 will meaſure the 4th antecedent and conſequent, and the quotients will be 1 and 2: Now there being 2 left on each ſide, they cancel each other, and as there is no farther room for abridging, by reaſon of the odd number 379, the operation is finiſhed, and the anſwer found, as above.

2. If 20lb. at Boſton make 23lb. at Antwerp, and 155 at Antwerp make 180 at Leghorn; how many at Boſton are equal to 144 at Leghorn?

Antecedents.	Conſequents.	
lb.	lb.	
20 of Boſton	= 23 of Antwerp.	20×155×144=446400div.
155 of Antwerp	= 180 of Leghorn,	23×180=4140 Diviſor.
144 of Leghorn.		4140)446400(107$\frac{120}{23}$ *Anſ.*

Or, abridged, $\frac{155 \times 144}{23 \times 9} = 107\frac{120}{23}$.

3. If 12lb. at Boſton make 10 at Amſterdam, 100lb. at Amſterdam, 120 at Paris; how many lb. at Boſton are equal to 80lb. at Paris? *Anſ.* 80lb.

4. If 140 braces at Venice be equal to 150 braces at Leghorn, and 7 braces at Leghorn be equal to 4

American

American yards; how many Venetian braces are equal to 32 American yards; *Anſ.* $52\frac{4}{15}$

5. If 40lb. at Newburyport make 36 at Amſterdam, and 90lb. at Amſterdam make 116 at Dantzick; how many pound at Newburyport are equal to 260lb at Dantzick? *Anſ.* $224\frac{4}{25}$.

CASE II.

When it is required to find how many of the laſt ſort of coin, weight or meaſure mentioned in the queſtion, are equal to a given quantity of the firſt.

RULE. Place the numbers alternately, beginning at the left hand, and let the laſt number ſtand on the right hand; then multiply the firſt row for a diviſor, and the ſecond for a dividend.

EXAMPLES.

1. If 12lb. at Boſton make 10lb. at Amſterdam, and 100lb. at Amſterdam make 120 at Paris: how many at Paris are equal to 80 at Boſton?

	Left.	Right.
Boſton	12.	10
Amſterdam	100.	120.

$10 \times 120 \times 80 = 96000$

$80\ 12 \times 100 = 1200$ $\qquad \frac{96000}{1200} = 80$ *Anſ.*

2. If 40lb. at Newburyport make 36 at Amſterdam, and 90lb. at Amſterdam make 116 at Dantzick; how many lb. at Dantzick are equal to 244 at Newburyport? *Anſ.* $283\frac{12}{25}$.

ARBITRATION OF EXCHANGES.

By this term is underſtood how to chooſe, or determine the beſt way of remitting money from abroad with advantage; which is performed by conjoined proportion: Thus,

Suppoſe a merchant has effects at Amſterdam to the amount of 3530 dollars, which he can remit by way of Liſbon at 840 rees per dollar, and thence to Boſton; at

8s. 1d. per millree (or 1000 rees ;)—Or, by way of Nantz, at $5\frac{2}{3}$ livres per dollar, and thence to Boſton at 6s. 8d. per crown : . It is required to arbitrate theſe exchanges, that is, to chooſe that which is moſt advantageous ?

1 Dollar at Amſterdam=840 rees at Liſbon.
1000 rees at Liſbon = 97d. at Boſton.
3530 Dollars at Amſterdam.

$\frac{840 \times 97 \times 3530}{1000 \times 1} = 1:981.$ 8s. $8\frac{4}{10}$d. By way of Liſbon.

1 Dollar at Amſt.=$5\frac{2}{3}$ livres at Nantz.
6 Livres at Nantz=80 pence at Boſton.
3530 dollars at Amſterdam.

$\frac{5\frac{2}{3} \times 80 \times 3530}{1 \times 6} = £1059$ By way of Nantz.

Here it may be obſerved, that the difference is 139l. 8s. $8\frac{4}{10}$d. in favour of remitting by way of Liſbon rather than by Nantz, which depends on the courſe of exchange, at that time ; but the courſe may vary ſo, that in a ſhort time, by way of Nantz may be better ; hence appears the neceſſity and advantage of an extenſive correſpondence, to acquire a thorough knowledge in the courſes of exchange, to make this kind of remittance.

FELLOWSHIP.

The Rules of Fellowſhip are thoſe by which the accounts of ſeveral merchants, or other perſons, trading in partnerſhip, are ſo adjuſted, that each may have his ſhare of the gain, or ſuſtain his ſhare of the loſs, in proportion to his ſhare of the joint ſtock, together with the time of its continuance in trade.

SINGLE FELLOWSHIP

Is, when the ſtocks are employed for any certain *equal time*.

RULE.

RULE.* As the whole ſtock is to the whole gain or loſs; ſo is each man's particular ſtock, to his particular ſhare of the gain or loſs.

PROOF. Add all the particular ſhares of the gain or loſs together, and if it be right, the ſum will be equal to the whole gain or loſs.

EXAMPLES.

1. Divide the number 360 into 4 ſuch parts, which ſhall be to each other as 3, 4, 5, & 6.

As 3+4+5+6 : 360 :: $\left\{\begin{array}{l} 3 : 60 \\ 4 : 80 \\ 5 : 100 \\ 6 : 120 \end{array}\right\}$ *Anſ.*

360 Proof.

2. A, B, C and D companied;—A put in 145l.; B 219; C 378, and D 417, with which they gained 569l.; what was the ſhare of each?

		£.	s.	d.	ſhare.
Whole Stock. Gain.	145 :	71	3	$8\frac{1}{2}\frac{10}{11}\frac{8}{39}$	A's
As 145+219+378+417 : 569 ::	219 :	107	10	$3\frac{3}{4}\frac{3}{11}\frac{75}{39}$	B's
	378 :	185	11	$6\frac{5}{11}\frac{52}{39}$	C's
	417 :	204	14	$5\frac{1}{4}\frac{33}{11}\frac{3}{39}$	D's

£569 ———Proof.

3. A, B, C and D are concerned in a joint ſtock, of 168l. 2s. 6d.; of which A's part is 25l. 10s B's 37l. 15s. C's 49l. and D's 55l. 17s. 6d: Upon the adjuſtment of their accounts, they have loſt 73l. 13s. 4d.: What is the loſs of each?

Anſ. A's loſs 11l. 3s. $5\frac{1}{4}$d. B's 16l. 10s. $9\frac{1}{4}$d. C's 21l. 9s. $4\frac{3}{4}$d. and D's 24l. 9s. $7\frac{1}{4}$d.

4. A

* That their gain or loſs, in this rule, is in proportion to their ſtock, is evident: For, as the times in which the ſtocks are in trade, are equal, if I put in $\frac{1}{2}$ the whole ſtock, I ought to have $\frac{1}{2}$ of the gain.

4. A and B companied: A put in 45l. and took $\frac{2}{3}$ of the gain: What did B put in?

5—3=2. Then, as 3 : 45 :: 2 : 30 *Anſ.*

5. A, B and C freighted a ſhip, with 68900 feet of boards: A put in 16520 feet; B 28750; and C the reſt: But, in a ſtorm, the Captain threw overboard 26450 feet: How much muſt each ſuſtain of the loſs?

Anſ. A 6341$\frac{1}{4}$ feet; B 11036$\frac{1}{4}$, and C 9071$\frac{1}{2}$ feet.

6. A gentleman died, leaving three ſons and a daughter; to whom he bequeathed his eſtate in the following manner: To the eldeſt ſon, he gave 312 moidores; to the ſecond, 312 guineas; to the third, 312 piſtoles; and to the daughter, 312 dollars; but when his debts were paid, there were but 312 half joes left: What muſt each have in proportion to the legacies which had been bequeathed them?

Anſ 1ſt ſon 293l. os. 2d.—2d. ſon 227l. 17s. 10$\frac{3}{4}$d. 3d. ſon 179l. 1s. 2$\frac{1}{2}$d.—and the daughter 48l. 16s. 8$\frac{1}{4}$d.

7. A ſhip worth 780l. being loſt at ſea, of which $\frac{1}{6}$ belonged to A, $\frac{1}{2}$ to B, and the reſt to C; what loſs will each ſuſtain, ſuppoſing 450l. to have been inſured upon her?

786—450=330; then $\frac{1}{6}$)330 $\frac{1}{2}$)330 $\frac{1}{3}$)330

£55=A's £165=B's £110=C's ſhare.

8. A and B venturing equal ſums of money, cleared by joint trade 140l.: By agreement, as A executed the buſineſs, he was to have 8 per cent. and B was to have 5 per cent.; what was A allowed for his trouble?

£. £. £. £. £. £. £. £. £. £.

As 8+5 : 140 :: 8 : 86$\frac{2}{13}$ & As 8+5 : 140 :: 5 : 53$\frac{11}{13}$.

Anſ. 3zl. 6s. 1$\frac{3}{4}$d. $\frac{5}{13}$.

9. A bankrupt is indebted to A 120l. to B 230, to C 340, and to D 450, and his whole eſtate amounts only to 560l.; how muſt it be divided among the creditors?

Anſ.

Anſ. A 58l. 18s. 11¼d. B 112l. 19s. 7¼d. C 167l. 0s. 4d. D 221l. 1s. 0½d.

10. A, B and C put their money into a joint ſtock; A put in 40l. B and C together 170l.; they gained 126l. of which B took 42; what did A and C gain, and B and C put in reſpectively?

As 210 the whole ſtock : 126 the whole gain :: 40 A's ſtock : 24 A's gain.

As 24l. A's gain : 40 A's ſtock :: 42 B's gain : 70 B's ſtock. Then £170—£70=£100 C's ſtock; and the whole gain £126—£66 A's and B's gain=£60 C's gain.

11. A, B and C companied: A put in 40l.; B 60l. and C a ſum unknown: They gained 72l.; of which C took 32 for his ſhare: What did A and B gain, and C put in?

The whole gain £72—C's gain £32=40 A's and B's gain: Then, As 100l. A's and B's ſtock : 40l. their gain :: 40l. A's ſtock : 16l. his gain. Again, As 16l. A's gain : 40l. his ſtock :: 32l. C's gain : 80l. his ſtock.

12. A, B and C put in 720l. and gained 540l. of which, ſo often as A took up 3l. B took up 5, and C 7; what did each put in and gain?

Money taken up.

As 3+5+7+ : 540 :: { 3 : 108 A's gain. / 5 : 180 B's ditto. / 7 : 252 C's ditto.

And, as 3+5+7 : 720 :: { £. 3 : 144 A's ſtock. / 5 : 240 B's ditto. / 7 : 336 C's ditto.

Or, you may find a common multiplier to multiply the proportions by, or multiplicand to be multiplied by the given proportions, thus, 15)720(48 multiplicand, to find the ſtocks—and 15)540(36 multiplicand, to find the gains.

£.
48X3=144 A's ſtock.
48X5=240 B's ditto.
48X7=336 C's ditto.

and

£.
36X3=108 A's gain.
36X5=180 B's do.
36X7=252 C's do.

(as before

13. A, B C and D companied, and gained a ſum of money; of which A, B and C took 120l. B, C and D, 180l. C, D and A 160l. and D, A and B, 140l.; what diſtinct gain had each?

The ſum of theſe 4 numbers is 600l. and as each man's money is named 3 times, therefore $\frac{1}{3}$, viz. 200l. is the whole gain—Therefore 200l.—120 A's, B's and C's gain=80 D's gain:—And 200—180 B's C's and D's gain=20 A's gain. 200—160 C's D's and A's gain=40 B's gain. And £200—140 D's, A's and B's gain=60 C's gain.

14. Two merchants companied: A put in 40l. and B 288 ducats: They gained 135l. of which A took 60l.; what was the value of a ducat?

As 60, A's gain: 40 his, ſtock :: 135, the whole gain—60 A's gain: 50 B's gain.

Duc. £. Duc. s. d.

And, as 288 : 50 :: 1 : 3 $5\frac{3}{5}$ Anſ.

15. Four men ſpent at a reckoning, 20 ſhillings; of which they agreed that A ſhould pay $\frac{2}{4}$, B, $\frac{1}{2}$, C, $\frac{1}{4}$, and D, $\frac{1}{8}$; what muſt each proportion?

			s. d.	s. d.	
Shares to be paid	s.	15	: 9	$2\frac{10}{13}$	
As $\frac{2}{4}+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}$	: 20 ::	10	: 6	$1\frac{11}{13}$	Anſ.
		5	: 3	$0\frac{11}{13}$	
		2 6	: 1	$6\frac{6}{13}$	

DOUBLE FELLOWSHIP,*

Or, *Fellowſhip with Time*, is occaſioned by the ſhares of partners being continued unequal times.

Rule. Multiply each man's ſtock, or ſhare, by the time it was continued in trade: Then,

As the whole ſum of the products, is to the whole gain or loſs:

So

* When the times are equal, the ſhares of the gain or loſs are evidently as the ſtocks, as in Single Fellowſhip; and when the ſtocks are equal, the ſhares are as the times; wherefore, *when neither* are equal, the ſhares muſt be as their products.

So is each man's particular product to his particular share of the gain or loss.

1. A, B and C hold a pasture in common, for which they pay 40l. per annum. A put in 9 oxen for 5 weeks; B, 12 oxen for 7 weeks, and C, 8 oxen for 16 weeks; what must each pay of the rent?

$9 \times 5 = 45$. $12 \times 7 = 84$, and $8 \times 16 = 128$; then $128 + 84 + 45 = 257$.

As 257 : 40 :: 45

45

200
160

257)1800(7
1799

1
20

257)20(0
12

257)40(0
4

257)960(3
771

189

As 257 : 40 :: 84

84

160
320

257)3360(13
257

790
771

19
20

257)380(1
257

123
12

257)1476(5
1285

191
4

257)764(2
514

250

As 257 : 40 :: 128

40

257)5120(19
257

2550
2313

237
20

257)4740(18
257

2170
2056

114
12

257)1368(5
1285

83
4

257)332(1
257

75

2. Four merchants traded in company; A put in 100l. for 5 months; B, 150l. for 7 months; C 220 for 8 months; and D, 310 for 9 months; but by misfortunes

fortunes at ſea they loſt 145l. ; what muſt each man uſtain of the loſs ?

Anſ. { A, £11 17/8 $\frac{1}{4}$ $\frac{11}{61}$ C, £41 16/8 $\frac{1}{2}$ $\frac{38}{61}$; B, 24 19/2 $\frac{40}{61}$ D, 66 6/4 $\frac{1}{2}$ $\frac{54}{61}$ }

3. A with a capital of 100l. began trade, January 1ſt, 1792, and meeting with ſucceſs in his buſineſs, he took in B as a partner on the firſt day of March following, with a capital of £150. Three months after that, they admit C, as a third partner, who brought into ſtock £180, and after trading together till the 1ſt of January, 1793, they found there had been gained ſince A's commencing buſineſs, £177 13s. How muſt this be divded among the partners ?

Anſ. A, £53 16/8—B, £67 5/10—C, £56 10/6.

4. Two merchants entered into partnerſhip for 18 months ; A, at firſt, put into ſtock, £100, and at the end of 8 months, he put in 50 more ; B, at firſt, put in £275, and at 4 month's end, took out £70. Now, at the expiration of the time, they found they had gained £263 : What is each man's juſt ſhare ?

Anſ. A, £96 9/6. B, £166 10/6.

5. A and B companied ; A put in the 1ſt of January, £150 ; but B could not put in any till the 1ſt of May : What did he then put in to have an equal ſhare with A, at the year's end ?

M. £. M.

As 12 : 150 :: 8 : $\frac{150 \times 12}{8}$ = £225 *Anſ.*

6. A, B and C companied ; A put in the 1ſt of March, £30 ; B the 1ſt of May, put in 80 yards of broadcloth ; and on the 1ſt of June, C put in 120 dollars. On the firſt of January following, they reckoned their gains, of which A and B took £228 ; B and C, £215 10s. and C and A £187 10s What was the whole gain, and the gain of each ? What did they value a yard of cloth at ? And what was C's dollar worth ?

228

228+215 10s+187 10s.=631l. ; and 631÷2=315 10s. the whole gain ; then 315l. 10s.—228=87l. 10s. C's gain, 315l. 10s.—215l. 10s.=100l. A's gain, and 315l. 10s.—187l. 10s.=128l. B's gain. To find the value of one yard of cloth ; ſay, As 100l. A's gain : 30 his ſtock :: 128 B's gain : 38l 8s. ; then, inverſely, As 10 months : 38l. 8s. :: 8 months : 48l. the value of the whole cloth. As 80 yds. : 48l. :: 1 yd. : 12s. anſwer. Now to find the value of a dollar ; As 100l. A's gain : 30 his ſtock :: 87l. 10s. C's gain : 26l. 5s. ; then, inverſely, As 10 months : 26l. 5s. :: 7 months : 37l. 10s. =120 dollars. Laſtly, As 120 dollars : 37l. 10s. :: 1 dollar : 6/3 anſwer.

FELLOWSHIP BY DECIMALS.

RULE. Divide the whole gain, or loſs, by the whole ſtock ; and the quotient multiplied ſeverally by each man's ſtock, will give the gain, or loſs, of each.

EXAMPLES.

1. A, B and C companied ; A put in 200l. B, 150, and C. 50, with which they gained 800 ; what is the ſhare of each ?

Anſ. 800÷400=2 ; then 200X2=£400=A's gain, 150X2=£300=B's gain, and 50X2=100= C's gain.

2. A, B, C and D trade, and gain 200l. which is to be divided in the following manner, viz. ſo often as A has 6l. B muſt have 10, C, 14, and D, 20 ; what is the ſhare of each ?

6+10+14+20=50, and $\frac{200}{50}$=4, quotient ; then 6X4=24l. A's gain ; 10X4=40l. B's gain ; 14X4 =56 C's ; and 20X4=80l. D's gain.

3. A, B and C companied; A put in 40l. 5s. B, 80l. 10s. and C 161l. with which they gained 120l.; what is each man's ſhare of the gain;

A's ſtock = 40,25
B's ditto = 80,5
C's ditto = 161

Sum total = 281,75) 120,000000 (,4259 +

,4259	,4259	,4259
40,25	80,5	161
21295	21295	4259
8518	340720	25554
170366		4259
	£34,28495	
£17,142475	20	£68,5699
20		20
	5,699200	
2,849500	12	11,3980
12		12
	8,388	
10,194000	4	4,776
4		4
	1,552	
0,776000		3,104

Proof, A's gain 17l. 2s. 10d. + B's gain 34l. 5s. 3¼d. + C's gain 68l. 11s. 4¾d. = 119l. 19s. 11d.

PRACTICE

Is a contraction of the Rule of Three Direct, when the firſt term happens to be a unit, or one; and has its name from its daily uſe among merchants and tradeſmen, being

ing an eaſy and conciſe method of working moſt queſtions which occur in trade and buſineſs.*

The method of proof is by the Rule of Three, Compound Multiplication, or by varying the order of them.

Before the queſtions hereafter given, can be wrought, the following tables muſt be perfectly gotten by heart.

TABLES.

*General Rule.

1. Suppoſe the price of the given quantity to be 1l. or 1s. &c. then will the quantity itſelf be the anſwer at the ſuppoſed price.

2. Divide the given price into aliquot parts, either of the ſuppoſed price, or of one another, and the ſum of the quotients belonging to each will be the true anſwer required.

Example.

What is the value of 468 yards at 2/9¼ per yard?

£468	s.	d.	Anſwer at £1	s	d.
2s. 6d. is ¼ =	58	10 —	ditto at —	2	6
3d. is $\frac{1}{10}$ =	5	17 —	ditto at — —		3
¼d. is $\frac{1}{12}$ =	—	9 9	ditto at — — —		¼
The full price = £64	16	9	—	2	9¼

In this example, it is plain that the quantity 468 is the anſwer at 1l.; conſequently, as 2/6 is ¼ of a pound, ¼ part of that quantity, or 58l. 10s. is the price at 2/6; in like manner, as 3d. is the $\frac{1}{10}$ part of 2s. 6d. ſo $\frac{1}{10}$ part of 58l. 10s. or 5l. 17s. is the anſwer at 3d. and as ¼d. is $\frac{1}{12}$ of 3d. ſo $\frac{1}{11}$ of 5l. 17s. or 9s. 9d. is the anſwer at ¼d. Now as the ſum of all theſe parts is equal to the whole price (2s. 9¼d.) ſo the ſum of the anſwers belonging to each price will be the anſwer at the full price required, and the ſame will be true in any example whatever.

TABLES.

Aliquot, or even parts of Money | *Aliquot, or even parts of* Weight.

Pts. of a shil. of a £.		
d.	s.	£.
5 =	½ =	1/40
4 =	1/3 =	1/60
3 =	¼ =	1/80
2 =	1/6 =	1/120
1½ =	⅛ =	1/160
1 =	1/12 =	1/240
¾ =	1/16 =	1/320
½ =	1/24 =	1/480
¼ =	1/48 =	1/960

Parts of a shilling.	
d.	2s.
1 is	1/24
1½ —	1/16
2 —	1/12
3 —	⅛
4 —	1/6
6 —	¾
8 —	⅔

Pts of a pound		
s.	d.	£.
10	0 is	½
6	8 —	1/3
5	0 —	¼
4	0 —	1/5
3	4 —	1/6
2	6 —	⅛
1	8 —	1/12
1	4 —	1/13
1	3 —	1/16
1	0 —	1/20
0	10 —	1/24
0	8 —	1/30
0	5 —	1/48
0	2½ —	1/96

Parts of a Cwt		
Qrs.	lb.	Cwt.
2	0 is	½
1	0 —	¼
0	16 —	⅛
0	14 —	1/16
0	8 —	1/28
0	7 —	1/32
0	4 —	1/56

Pts. of ½ Cwt	
lb.	½ Cwt.
28 is	½
14 —	¼
8 —	1/7
7 —	⅛
4 —	1/14

Pts of ¼ Cwt.	
lb.	¼ Cwt.
14 is	½
7 —	¼
4 —	1/7
2 —	1/14

Pts. of a ton.		
Cwt.	qr.	T.
10	0 is	½
5	0 —	¼
4	0 —	1/5
2	2 —	⅛
2	0 —	1/10
1	1 —	1/16
1	0 —	1/20

Parts of 240.	
180	is ¾
120	— ½
80	— ⅓
60	— ¼
40	— 1/6

Parts of 480	
360	is ¾
160	— ⅓

Another TABLE of Aliquot Parts of Money.

Parts of a shilling.	
d.	s.
10	is 5/6
9	— ¾
8	— ⅔
7½	— 5/8
4½	— ⅜

Parts of a pound.		
s.	d.	£.
18	0 is	9/10
17	6 —	7/8
16	8 —	5/6
16	0 —	4/5
15	0 —	¾
14	0 —	7/10

Parts of a pound.		
s.	d.	£.
13	4 is	⅔
12	6 —	5/8
12	0 —	3/5
8	0 —	2/5
7	6 —	⅜
6	0 —	3/10

A TABLE of DISCOUNT per cent.

£.	s. d.		£.	s. d.		£.	s. d.	
1¼	0 3		8¾	1 9		22½	4 6	
2½	0 6		10	2 0		25	5 0	
3¾	0 9	per cent. is	12½	2 6	per cent. is	30	6 0	per cent. is
5	1 0		15	3 0		35	7 0	
6¼	1 3		17½	3 6		40	8 0	
7½	1 6	on the pound.	20	4 0	on the pound.	45	9 0	on the pound.
						50	10 0	

CASE I.

When the price of 1 *yard*, 1*lb.* &c. *is an even part of one ſhilling* ;—Find the value of the given quantity at 1s. per yard, lb. &c. then draw a line underneath, and divide it by that even part, and the quotient will be the anſwer in ſhillings ; which muſt always be brought into pounds.

EXAMPLES.

1. What will $354\frac{1}{2}$ yards coſt, at $\frac{1}{4}$d. per yard ?

s. d.

$\frac{1}{4}$d. | $\frac{1}{4}$ | 354 6 value of $354\frac{1}{2}$ yards at 1s. per yard.

Anſ. £0 7 $4\frac{1}{2}$ value of $354\frac{1}{2}$ yards, at $\frac{1}{4}$d. per yard.

Or thus, Or divide by 8 and 6 thus ; 8)354 6

£. s. d. s. d.

2)17 14 6=354 6 6)44 $3\frac{3}{4}$

6)2 4 $3\frac{3}{4}$ *Anſ.* 7 $4\frac{1}{2}$ as before.

7 $4\frac{1}{2}$ *Anſ.* as before.

2. What will $759\frac{1}{4}$ yards come to, at 3d. per yard ?

s. d.

3d. | $\frac{1}{4}$ | 759 9 value at 1s. per yard.

2|0)18|9 $11\frac{1}{4}$

Anſ. 9 9 $11\frac{1}{4}$ value at 3d. per yard.

Or, thus :

£. s. d.

3d. | $\frac{1}{4}$ | 37 19 9 value at 1s. per yard.

Anſ. £ 9 $11\frac{1}{4}$ value of $759\frac{1}{4}$ yds. at 3d. per yd.

Questions. Yds.			Answers. £.	s.	d.
3d.	642 at ¼d.	per yd.	0	13	4½
4th.	918¼ — ½d.	—	1	18	3½
5th.	739½ — 1d.	—	3	1	7½
6th.	567½ — 1½d.	—	3	10	11¼
7th.	685¾ — 2d.	—	5	14	3½
8th.	475¼ — 4d.	—	7	18	5
9th.	913½ — 6d.	—	22	16	9

CASE II.

When the price is pence, and no even part of a shilling; Find the value of the given quantity at 1s. per yard; divide the pence into aliquot parts, for divisors; and the sum of the quotients, arising from them will be the answer.

Examples.

1. What will 487½ yards come to at 5d. per yard?

		£.	s.	d.	
3d.	¼	24	7	6	value of 487½ yards at 1s. per yd.
2d.	⅙				
		6	1	10½	value of ditto, at 3d per yard.
		4	1	3	value of ditto, at 2d. per yard.
Anſ.		£10	3	1½	value of ditto at 5d. per yard.

Questions. Yds.			Answers. £.	s.	d.
2d.	568¼ at	7d. —	16	11	5¾
3d.	683¾ —	8d. —	22	15	10
4th.	912½ —	9d. —	34	4	4½
5th.	649¼ —	10d. —	27	1	0½
6th.	745¾ —	11d. —	34	3	7¼

CASE

CASE III.

When the price is pence or farthings, and an even part of a pound, cut off the right hand figure of the given quantity; and the cypher, in the aliquot part (if it has one) and divide by the remaining figure or figures: When you come to the remainder double it; and divide as before; the anſwer will be pounds, ſhillings, &c. If there be no cypher in the diviſor, then none ſhould be cut off from the dividend.

Examples.

d.
$\frac{1}{4}|\frac{1}{96}\cdot v|$3795 lb. at $\frac{1}{4}$d.
96=8×12)37915*

8)31 12 6

Anſ. £3 19 0¾

d.
$\frac{1}{2}|\frac{1}{48}\cdot v|$3795 yds at ½d.
48=6×8)37915

6)47 8 9

Anſ. £7 18 1½

$\frac{1}{8}|\frac{1}{32}\cdot v|$3795 yds at ¼d.
32=4×8)37915

4)47 8 9

Anſ. £11 17 2¼

1 $|\frac{1}{24}\cdot v|$ 3795 yds. at 1d.
24=4×6)37915

4)63 5

Anſ. £15 16 3

d.
$1\frac{1}{2}|\frac{1}{16}\cdot v|$3795 yds. at 1½d.
16=4×4)37915

4)94 17 6

£23 14 4½ *Anſ.*

d.
$2|\frac{1}{12}\cdot v)$37915 yds at 2d.

£31 12 6 *Anſ.*

$3|\frac{1}{8}\cdot v|$37915 yds. at 3d.

£47 8 9 *Anſ.*

* In dividing by 12, there remains 7 before the ſtroke, which *ſeparates the 5; then 75* doubled, is 150; and 12 is found 12½ *times in 150; which* makes 12s. 6d.

d.
4 | 3795 yds at 4d

£63 5 *Anſ.*

d.
6 | 3795 yds. at 6d.

£94 17 6 *Anſ.*

d.
8 | 3295 yds. at 8d.

£126 10 *Anſ.*

d.
10 | 3795 yds.

24=4X6)3795

4)632 10

£158 2 6 *Anſ.*

CASE IV.

When the price is between one and two ſhillings;—Find the value of the quantity at 1s. per yard, &c. which value being divided by thoſe even parts which the pence are of 1s. and the quotient or quotients, ariſing therefrom, added thereto;—the ſum will be the anſwer.

EXAMPLES.

1. What will 758½ yards, at 1/9 per yard, come to?

		£.	s.	d.	
6d.	½	37	18	6	value at 1s. per yard.
3d.	¼	18	19	3	value at 6d. per yard.
		9	9	7½	value at 3d. per yard.

Anſ. £66 7 4½ val. of 758½ yds. at 1/9 per yd.

Queſtions.	Yds.			Anſwers. £.	s.	d.
2d.	987½	at	12½d.	—51	8	7¼
3d.	793	—	12¾d.	—42	2	6¾
4th.	847½	—	13s. 1d.	—45	18	1½

Queſtions.

Queſtions. Yds.			Anſwers. £.	s.	d.
5th. 686¼ at	1s.	1½d.	—38	12	7
6th. 591¼ —	1s.	2d.	—34	9	9½
7th. 573½ —	1s.	3d.	—35	16	10½

CASE V.

When the price is any even number of ſhillings under 24;—Multiply the given quantity, by half the price, and double the firſt figure of the product for ſhillings; the reſt of the product will be pounds.

N. B. If the price be 2s. you need only double the unit figure for ſhillings; the other figures will be pounds.

EXAMPLES.

1. What will 746 yards coſt [illegible] per yard?

746

Anſ. £74 12 value at 2s. per yard?

Note. The above is done, by ſaying, twice 6 (the unit figure) is 12; the other figures, viz. 74, are pounds.

2. What will 567¼ yards, at 2s. per yard come to?

Anſ. 56l. 15/6.

N. B. Before I double the unit figure, viz. 7, I conſider, that ¼ of a yard at 2s. per yard, will amount to 1/6; then, I double 7, which makes 14s. and 1/6 added, makes 15/6; the other figures are pounds.

Queſtions. Yds.			Anſwers. £.	s.	d.
3d. 129½ at	4s.	per yard,	25	18	0
4th. 697 —	6s.	———	209	2	0
5th. 845 —	9s.	———	338	0	0
6th. 917¼ —	10s.	———	458	12	6

CASE

CASE VI.

When the price wants an even part of 2s.—Firſt, find the value of the whole quantity at 2s. per lb. yard, &c. then divide it by that even part which is wanting; and ſubtract this quotient from the value at 2s. the remainder will be the anſwer.

Examples.

1. What will $95\frac{1}{2}$ yards coſt, at 22d. per yard?

		£.	s.	d.	
2d.	$\frac{1}{12}$	9	11	0	value at 2s. per yard.
		0	15	11	ditto at 2d. per yard.
Anſ.		£8	15	1	value at 1s. 10d. per yard.

Queſtions. Yds.			Anſwers. £.	s.	d.
2d.	64	23d. per yard,	6	2	8
3d.	128	$\frac{1}{2}$d. ———	12	0	0
4th.	$246\frac{1}{2}$	— 21d. ———	21	11	$4\frac{1}{2}$
5th.	$375\frac{1}{4}$	— 20d. ———	31	5	5

CASE VII.

When the price is between 2s. *and* 3s.—Firſt, find the value of the quantity, at 2s. per yard, &c. which value being divided by thoſe even parts, which the pence are of 2s. and thoſe quotients added thereto, the ſum will be the anſwer.

Examples.

1. What will $148\frac{1}{2}$ yards come, at 2s. 7d. per yard?

		£.	s.	d.	
4d.	$\frac{1}{6}$	14	17	0	value at 2s. per yard.
3d.	$\frac{1}{8}$	2	9	6	ditto at 4d. per yard.
		1	17	$1\frac{1}{2}$	ditto at 3d. per yard.
Anſ.		£19	3	$7\frac{1}{2}$	value at 2s. 7d. per yard.

Queſtions.

Queſtions. Yds.				Anſwers. £. s. d.
2d.	$266\frac{1}{4}$ at	2s. 1d.	per yard,	27 14 $8\frac{1}{4}$
3d.	344 —	2s. $1\frac{1}{2}$d.	———	36 11 0
4th.	$543\frac{1}{2}$ —	2s. 2d.	———	58 17 7
5th.	$655\frac{3}{4}$ —	2s. 3d.	———	73 15 $5\frac{1}{4}$

CASE VIII.

When there are pence in the price which are an even part of a ſhilling, beſides an even number of ſhillings under 20;—Firſt, find the value of the quantity at the ſhillings per yard, &c. according to Caſe 5th; then, ſuppoſe the quantity to ſtand as ſhillings per yard; divide it by that even part, which the pence are of 1s. and this quotient being added to the value before found, the ſum will be the anſwer.

Examples.

1. What will $156\frac{1}{2}$ yards come to, at 6*ſ*4 per yard;

Yds.
$156\frac{1}{2}$
3

d. s. d.
4 $\frac{1}{3}$ | 156 6

£46 19 0 value of $156\frac{1}{2}$ yds. at 6s. per yd.
52s. 2d. = 2 12 2 value of ditto at 4d per yd.

Anſ. £49 11 2 value of ditto at 6*ſ*4 per yard.

Queſtions. Yds.				Anſwers. £. s. d.
2d.	$17\frac{1}{2}$ at	4 $0\frac{1}{4}$	per yard,	3 10 $8\frac{1}{4}$
3d.	$59\frac{3}{4}$ —	6 $0\frac{1}{4}$	———	18 2 $2\frac{3}{4}$
4th.	$68\frac{1}{4}$ —	8 1	———	27 11 $8\frac{1}{4}$
5th.	96 —	10 $1\frac{1}{2}$	———	48 12 0

CASE IX.

When the price is any odd number of ſhillings under 20; —Find the value of the greateſt even number contained

in

in the price, according to Case 5th, and add thereto the value of the quantity at 1s. per yard, &c. which sum will be the answer: Or, Multiply the quantity by the price, according to the 1st or 2d. Case, in Simple Multiplication; and divide the product by 20; the quotient will be the answer: Or, lastly, if the price be not more than 12s. find the value of the quantity at 1s. per yard, &c. and multiply it by the number of shillings in the price of 1 yard: The product will be the answer.

EXAMPLES.

1. What will 186 yards cost, at 3s. per yard?

£.	s.		Or thus:	£.	s.	
18	12	value at 2s. per yd.		9	6	value at 1s. per yd.
9	6	value at 1s. per yd.			3	
£27	18	*Ans.*	Product	27	18	*Ans.*

2. What will 647 yards cost, at 17s. per yard?

8

£	s.		
517	12	value at 16s. per yard.	
32	7	value at 1s. per yard.	
Ans. £549	19	value at 17s. per yard.	

Questions. Yds.		s.		Answers. £.	s.	d.
3d.	169¼	at 5	per yard,	42	6	3
4th.	248¾	— 7	- - -	87	1	3
5th.	139	— 9	- - -	62	11	0
6th.	782	—25	- - -	977	10	0

CASE X.

When the price is an even part of a pound;—Find the value of the given quantity, at one pound per yard, &c. then draw a line underneath and divide it by that part; the quotient will be the answer.

EXAMPLES.

EXAMPLES.

1. What will $156\frac{3}{4}$ yards of cloth come to, at 3s. 4d. per yard?

£.	s.	d.	
156	15	0	price at 1l. per yard.
			| 3s. 4d. | $\frac{1}{6}$ |
Anſ. £26	2	6	price at 3s. 4d. per yard.

Queſtions.	Yds.	s.	d.		*Anſwers.* £.	s.	d.
2d.	$516\frac{3}{4}$ at	1	0	per yard.	25	16	9
3d.	224 —	1	3	———	39	0	0
4th.	$719\frac{1}{2}$ —	1	4	———	47	19	4
5th.	648 —	1	8	———	54	0	0

CASE XI.

When the price wants an even part of a pound;—Firſt find the value of the given quantity at 1l. per yard, &c. then divide it by that even part which is wanting, and ſubtract this quotient therefrom: The remainder will be the anſwer.

EXAMPLES.

1. What will $167\frac{1}{2}$ yards coſt, at 17s. 6d. per yard?

s.	d.	£.	s.	d.	
		167	10	0	value at 1l. per yard.
		20	18	9	value at 2s. 6d. per yard.
Anſ. £146	11	3			value at 17s. 6d. per yard.
2	6				| $\frac{1}{8}$ |

Queſtions.	Yds.	s.	d.		*Anſwers.* £	s.	d.
2d.	$347\frac{1}{2}$ at	13	4	per yard.	231	13	4
3d.	$484\frac{3}{4}$ —	5	0	———	363	6	3
4th.	614 —	16	0	———	491	4	0
5th.	$912\frac{1}{4}$ —	17	6	———	798	4	$4\frac{1}{2}$

CASE XII.

When the price is ſhillings, pence and farthings, and not an even part of a pound;—Multiply the given quantity by the ſhillings in the price of 1 yard, &c. and take parts of parts from the quantity for the pence, &c. then add them together, and their ſum will be the anſwer, in ſhillings, &c. Or, you may let the given quantity ſtand as pounds, per yard, &c. then draw a line underneath, and take parts of parts therefrom; which add together, and their ſum will be the anſwer.

N. B. I adviſe the learner to work the following example both ways; by which means he will be able to diſcover the moſt conciſe method of performing ſuch queſtions in buſineſs, as may fall under this caſe.

What will 248½ yards at 7s. 6d. per yard come to?

d.		s.	d.	
6	½	248	6	value of 248½ yards, at 1s. per yard.
		7		
		1739	6	value of ditto at 7s. per yard.
		124	3	value of ditto at 6d. per yard.
20		186	3	9
Anſ.		93l.	3	9 value of ditto at 7s. 6d. per yard.

Or, thus:

d.		£.	s.	d.	
6	½	12	8	6	value of 248½ yards, at 1s. per yard.
Mult. by			7		
		86	19	6	value of ditto at 7s. per yard.
		6	4	3	value of ditto at 6d. per yard.
Anſ.		93	3	9	

By

By the latter part of this Caſe.

s.	d.	£.	s.	d.	
5	0	248	10	0	value of 248½yds. at 1l. per yard.
2	6	62	2	6	value of ditto at 5s per yard.
		31	1	3	value of ditto at 2s. 6d. per yard.
Anſ.		93	3	9	value of ditto, at 7s. 6d. per yard.

Queſtions.	Yds.	s.	d.		*Anſwers.* £.	s.	d.
2d.	68½ at	4	6	per yard.	15	8	3
3d.	124 —	5	8	- - -	35	2	8
4th.	146 —	14	9	- - -	107	13	6
5th.	218½—	12	6	- - -	136	11	3

CASE XIII.

When the price of the yard, lb. &c. is pounds, ſhillings and pence;—Firſt multiply the quantity by the pounds; and if the ſhillings and pence be an even part of a pound, divide the given quantity by that part, and add the quotient to the product for the anſwer: But if they be not an even part of a pound, you muſt take parts of parts, and add them together as before.——Or, reduce the pounds and ſhillings into ſhillings, and multiply the quantity thereby, after which take parts for the pence, and add the whole together, and their ſum will be the anſwer in ſhillings, &c.

N. B. The learner ſhould work the following queſtions both ways.

EXAMPLES.

1. What will 156 yards of broadcloth come to, at 3l. 6s 8 per yard?

6s 8	⅓	£. 156 0 0 value at one pound per yard.
		3
		468 0 0
		52 0 0
		Anſ. 520 0 0

Queſtions.

Queſtions.	Yds.		£. s. d.		*Anſwers.* £. s. d.
2d.	$345\frac{1}{2}$	at	6 5 0	per yard.	2159 7 6
3d.	$59\frac{3}{4}$	—	3 6 8	———	199 3 4
4th.	75	—	5 3 4	———	387 10 0
5th.	68	—	4 6 0	———	292 8 0

CASE XIV.

When the quantity is any number leſs than 1000 *and the price not more than* 12*d. per yard, &c.*—Find the value of the whole quantity at 1d. per yard, which may be done by dividing it by 12, mentally, ſetting downthe quotient only in pounds, or ſhillings, or both: Then multiply this ſum by the pence in the price of one yard, and the product will be the anſwer.

1. What will $759\frac{1}{2}$ yards coſt, at 7d. per yard?

£.	s.	d.	
0	63	$3\frac{1}{2}$	value at 1d. per yard.
Or, 3	3	$3\frac{1}{2}$	value at 1d. per yard.
Mult. by		7	
Anſ. 22	3	$0\frac{1}{2}$	val. of $759\frac{1}{2}$ yards, at 7d. per yard.

Queſtions.	Yds.		d.		*Anſwers.* £. s. d.
2d.	$975\frac{1}{2}$	at	2	per yard.	8 2 7
3d.	846	—	$3\frac{1}{4}$	———	12 6 9
4th.	$793\frac{3}{4}$	—	$4\frac{3}{4}$	———	15 14 $2\frac{1}{4}$
5th.	684	—	$5\frac{1}{2}$	———	15 13 6

CASE XV.

When the price is ſuch a number of ſhillings and pence, as when reduced into pence, may be produced by any two numbers in the Multiplication Table, and when the quantity does not exceed 1000;—Firſt find the value of the whole at 1d. per yard, &c. according to the laſt Caſe; then multiply this ſum by the component parts of the pence in the price and the laſt product will be the anſwer.

EXAMPLES.

EXAMPLES.

1. What will 493½ yards coſt at 6s. 9d. per yard?

£.	s.	d.	
1	16	7½	value at 1d. per yard.
		9	
16	9	7½	
		9	

Anſ. 148 6 7½ value at 81d. or 6s. 9d. per yard.

N. B. In 6s. 9d. there being 81d. I multiply by 9 twice becauſe 9 times 9 is 81.

Queſtions.					*Anſwers*		
	Yds.		s. d.		£.	s.	d.
2d.	984½	at	1 2	per yard	57	3	7
3d.	849¾	—	2 8	———	113	6	0
4th.	657	—	3 6	———	114	19	6
5th.	593	—	4 8	———	138	7	4

CASE XVI.

When the quantity is 240 ;—As many pence as there are in the price of 1 yard, &c. ſo many pounds will the quantity amount to.

N. B. One farthing per yard will come to 5s. at halfpenny per yard, to 10s. and at three farthings to 15s.

EXAMPLES.

1. What will 240 yards come to, at 2s. 7¼d. per yard? *Anſ.* 31l. 10s.

N B The price is 2/7¼ per yard :—Now, as in 2/7 there are 31 pence, ſo the quantity being 240, comes to 31 pounds; then according to the ſame rule, the halfpenny per yard comes to 10s. therefore, the anſwer to the queſtion is 31l 10s.

Queſtions.					*Anſwers.*	
	Yds.		s. d.		£	s.
2d.	240	at	1 7¾	per yard.	19	15
3d.	240	—	2 9	———	33	0
4th.	240	—	3 4	———	40	0
5th.	240	—	7 8½	———	92	10

CASE XVII.

When the quantity is not leſs than 228, *nor more than* 252 :— Firſt find the value of 240 yards, &c by the laſt Caſe ; then multiply the price of 1 yard by the number above or under 240, and add or ſubtract this product, to or from the value of 240 yards, as the queſtion may require ; and the ſum or remainder will be the anſwer.

EXAMPLES.

1. What will 248 yards come to at 16s. $5\frac{1}{2}$d. per yard ?

	£.	s.	d.	
	197	10	0	value of 240 yards.
16/$5\frac{1}{2}$ multiplied by 8=	6	11	8	value of 8 yards.
Anſ	204	1	8	value of 248 yards.

2. What will 229 yards coſt, at 5s. $9\frac{3}{4}$d. per yard.

	£.	s.	d.	
	69	15	0	value of 240 yards.
5/$9\frac{3}{4}$ multiplied by 11=	3	3	$11\frac{1}{4}$	value of 11 yards.
Anſ.	66	11	$0\frac{3}{4}$	value of 229 yards.

Queſtions.	Yds.	s.	d.		*Anſwers.* £.	s.	d.
3d.	228	at 6	$10\frac{1}{2}$	per yard.	78	7	6
4th.	252	— 4	6	———	56	14	0

CASE XVIII.

When the price of one hundred weight is of ſeveral denominations and the quantity likewiſe ;—Multiply the price by the integers, (that is the whole numbers) and take parts for the reſt from the price of an integer ; which, added together, will be the anſwer.

EXAMPLES.

1. What will 9Cwt. 3qrs. 14lb. of ſugar come to, *at* 4*l.* 17*s.* 4d. per Cwt. ?

qrs.

qrs.	lb.	
2	0	½
1	0	¼
0	14	⅛

£.	s.	d.		Cwt.	qrs.	lb.
4	17	4	price of 1 Cwt.			
	9					
43	16	0	price of	9	0	0
2	8	8	price of	0	2	0
1	4	4	price of	0	1	0
0	12	2	price of	0	0	14
Anſ. 48	1	2	price of	9	3	14

Queſtions.	Cwt.	qrs.	lb.		£.	s.	d		*Anſwers.* £.	s.	d.
2d.	8	1	16	tobacco, at	5	17	9	per cwt.	49	8	2¼
3d.	7	3	19	———	7	12	8	———	60	9	0½
4th.	12	1	24	———	3	18	10	———	49	2	7¼
5th.	16	2	17	———	2	15	11	———	46	11	1

CASE XIX.

When the price is at any of the rates in the ſecond Practice Table of aliquot parts;—Multiply the given quantity by the numerator, and divide that product by the denominator; if the price be pence, the quotient will be the anſwer in ſhillings; if ſhillings, the anſwer will be pounds.

Examples.

1. What will 379 yards at 4½d. per yard, come to?

379
3

8)1137

2|0)14|2 1½

Anſ. £7 2 1½

2. What will 149 yards, at 6s. per yard, come to?

149
3

10)44|7

Anſ. £44 14

Queſtions

Questions.					*Answers.*		
	Yds.	s.	d.		£.	s.	d.
3d.	127 at	0	7½	per yard.	3	19	4½
4th.	159 —	0	8	———	5	6	0
5th.	173 —	0	9	———	6	9	9
6th.	241 —	0	10	———	10	0	10
7th.	249 —	7	6	———	93	7	6
8th.	357 —	12	6	———	223	2	6
9th.	345 —	13	4	———	230	0	0

CASE XX.

When the price is any even number of ſhillings, if it be required to know what quantity of any thing may be bought for ſo much money ;—Annex a cypher to the money, and divide it by half the price, and the quotient will be the quantity to be purchaſed.

EXAMPLES.

1. How many yards of cloth, at 18s. per yard may I have for 345l. ?

Half the price=9)3450=Money with a cypher annexed.

383⅓ Yards, *Anſ.*

Questions.				*Answers.*
		s.	£.	Yds.
2d.	How many yds. at	2 per yd. for	427 ?	4270
3d.	———	4 ———	312 ——	1560
4th.	———	6 ———	917 ——	3056⅔
5th.	———	8 ———	195 ——	487½

CASE XXI.

To find the diſcount of any invoice, or bill of parcels, at any rate per cent. ——Multiply the pounds in the invoice by the amount of the diſcount of one pound, at the rate per cent. and take parts for the ſhillings and pence ; then add them together, and the ſum will be the diſcount required.

N. B. The diſcount for 1 pound at any rate per cent. is in the 3d Practice Table, page 184.

EXAMPLES.

EXAMPLES.

1. What is the diſcount of an invoice, amounting to 65l. 13s. 4d. at $7\frac{1}{2}$l. per cent. ?

OPERATION.

	£.	s.	d.
The diſcount of 65l. at 5l per cent. is 65s. or	3	5	0
The diſcount of 65l. at $2\frac{1}{2}$ per cent. is	1	12	6
The diſcount of 10s. being half a pound, at $7\frac{1}{2}$l. per cent. is	0	0	9
The diſcount of 3s. 4d. being $\frac{1}{6}$ of a pound at $7\frac{1}{2}$l. per cent. is	0	0	3
The ſum is	4	8	6

(Anſwer.

N. B. When the rate per cent. is any even part of 100l. it may be performed, by dividing the amount by that even part.

2. What is the diſcount of an invoice amounting to 57l. 13s. 9d. at $12\frac{1}{2}$l. per cent. ?

£.	s.	d.
57	13	9

$12\frac{1}{2}$	$\frac{1}{8}$

7 4 $2\frac{1}{2}$ Anſwer.

CASE XXII.

To find the value of goods ſold by particular quantities, viz. I. By the Score. II. Round Timber. III. By 5 Score to the Hundred. IV. By 112 to the Hundred. V. By 6 Score to the Hundred. VI. By the great Groſs VII. By the 1000.

I. *To find the value of goods ſold by the Score.*

The price of one is given, to find the price of one ſcore.

If the given price be ſhillings and pence, or only pence——Divide the given price, in pence, by 12 : The quotient will be the anſwer in pounds, and the remainder will be ſo many times 1/8.

EXAMPLES.

EXAMPLES.

1. At 9d. each; What is that per score?

12)9d.(,75=£0 15 0 *Anſ.*

Or, by inverting the queſtion.

1 Score = 20 = 1/8

9

15/0

2. At 4/9 each; what is that per score?

4/9

12

12)57d.

£4 15 *Anſ.*

It may be remarked, that when the price is ſhillings and pence, the anſwer will be juſt ſo many pounds as there are ſhillings, and ſo many times 1/8 as there are pence: If farthings are given; for ¼d. reckon 5d. for ½d 1cd. and for ¾d. 1/3.

TABLE of aliquot parts 20 the Integer.

2 is $\frac{1}{10}$	6 is $\frac{3}{10}$	12 is $\frac{6}{10}$	16 is $\frac{8}{10}$
4 — $\frac{1}{5}$	8 — $\frac{4}{10}$	14 — $\frac{7}{10}$	18 — $\frac{9}{10}$
5 — $\frac{1}{4}$	10 — $\frac{1}{2}$	15 — $\frac{3}{4}$	

3. What coſt 17, at 19/10 per ſcore.

		s.	d.
10	$\frac{1}{2}$	19	10
5	$\frac{1}{4}$		
2	$\frac{1}{10}$	9	11
		4	$11\frac{1}{2}$
		1	$11\frac{3}{4}$
17	=	16	$10\frac{1}{4}$

II Round Timber.

Forty feet make a load or ton, of round timber.

If the given price of a foot be ſhillings;—Multiply the given price by 2, and the product will be the anſwer in pounds.

4. What coſt a ton, at 3s. per foot?

3s × 2=£6 *Anſ.*

5. What coſt a ton, at 9s per foot?

9s. × 2=£18 *Anſ.*

If the given price of 1 foot be pence only, or ſhillings and pence——Divide the given price, in pence, by 6; the

the quotient will be the answer in pounds, and the remainder will be so many times 3/4.

6. What cost 40 feet at 17d. per foot?

6)17

£2 16 8 Ans.

7. At 1/9 per foot, What cost a ton?

6)21

£3 10 Ans.

If the given price of a foot be farthings only, or pence and farthings——Divide the given price, in farthings by 6, then, divide that quotient by 4, and this last quotient will be the answer.

8. At ¼d. per foot, What cost a ton?

6)3

4)- 10

£- 2 6 Ans.

9. At 13¼d. per foot, What cost a ton?

13¼

4

6)53

4)8 16 8

£2 4 2 Ans.

Or, Suppose every shilling in the price to be so many times 2l.: Every penny to be so many times 3/4: And every farthing to be 10d.

10. What cost 40 feet, at ¼d. per foot?

¼d. X 10=£0 2 6 *Ans.*

11. What cost 40 ft 15½d. per foot?

s.	d.		
1	0 X	2=	£2 0 0
3	4 X	3=	0 10 0
	½ X	10=	0 1 8

Ans. £2 11 8

III. *To find the value of goods sold by 5 Score to the Hundred.*

1. *If the given price be pounds and shillings, or shillings only*——Multiply the given price, in shillings, by 5; and the quotient will be the answer, in pounds.

12. At

12. At 19s. per yard, What coſt 100 yards?

19s.
5
£95 *Anſ.*

13. At 4l. 13s. per cwt. What coſt 100cwt. or 5 tons?

4 13
20
93
5
£465 *Anſ.*

2. *If the given price of* 1 *be pence only, or ſhillings and pence*—Multiply the given price, in pence, by 5; then divide that product by 12; the quotient will be pounds and the remainder ſo many times 1s. 8d.

14. If one yard coſt 9d.; what coſt 100 yards?

9
5
12)45
£3 15 *Anſ.*

3. *If the given price of* 1, *be ſhillings and pence*—Multiply the price by 5, and the product, under the place of ſhillings, will be the anſwer in pounds; and the product under the place of pence, will be ſo many times 1s. 8d.

15. At 2/5 per buſhel; What coſt 100 buſhels?

s.	d.
2	5
	5
12	1

Anſ. £12 2 8

16. At 25/3 per ton; What coſt 100 tons?

s.	d.
25	3
	5
126	3 1/8×3=5s.

£126 5 *Anſ.*

IV. To

4. *To find the price of one, at ſo much per hundred of 5 ſcore* —Multiply the given price by 12; divide the product by 5, and the quotient will be the anſwer in pence.

But if the price be pounds only; Divide the given price by 5, and the quotient will be the anſwer in ſhillings.

17. If 100 yards coſt £65; what coſt 1 yard?

5)65

13s. *Anſ.*

£11 7 9
12
5)136 13 0
12)27 6 7
2s. 3½d. *Anſ.*

18. If 100 yards coſt 11l. 17s. 9d. what coſt 1 yard?

In dividing 27 by 12 (in the 18th queſtion) the quotient is 2s. and the remainder 3d.—the 6 is $\frac{6}{10}$ of a penny=two farthings, and the 7 is of no account.

TABLE of Aliquot parts. 100 the Integer.

5 is $\frac{1}{20}$	25 is $\frac{1}{4}$	50 is $\frac{1}{2}$	75 is $\frac{3}{4}$
10 — $\frac{1}{10}$	30 — $\frac{3}{10}$	60 — $\frac{6}{10}$	80 — $\frac{8}{10}$
20 — $\frac{1}{5}$	40 — $\frac{4}{10}$	70 — $\frac{7}{10}$	90 — $\frac{9}{10}$

19. At 3l. 7s. 6d. per 100; what will 23 coſt?

		£. s. d.
20	$\frac{1}{5}$	3 7 6
		0 13 6
2	$\frac{1}{10}$	0 1 4 } Add.
1	$\frac{1}{20}$	0 0 9
23=		0 15 6 *Anſ.*

IV. *To find the value of goods ſold by 112lb. the cwt.*

The price of 1lb. is given to find the value of a cwt.

RULE. For a farthing account 2/4 per cwt. For a half penny, 4/8. For three farthings, 7s. and for every penny 9/4 per cwt.

20 What coſt 1cwt. at 3½d. per lb. ?

At 1d. per lb. s. d.
1cwt. coſts 9 4
3

At 3d. £1 8 0 } Add.
At ½d. £0 4 8 }

£1 12 8 *Anſ.*

21. At 8¼d. per lb. what coſt 1cwt ?

At 1d. per lb. s. d.
1cwt. coſts 9 4
8

At 8d. £3 14 8 } Add.
At ¼d. £0 7 0 }

Anſ. £4 1 8

V. *To find the value of goods ſold by* 6 *Score to the hundred.*

The price of one is given, to find the price of one hundred.

RULE. Suppoſe every penny in the price to be ſo many pounds, and for the farthings, ſuch a part of a pound as they are of a penny ; then, half of that ſum will be the anſwer.

22. At 4¼d. per yard, what coſt 120 yards ?

£. s.
2)4 10

2 5 *Anſ.*

23. At 16s. 9¼d. per yard, what coſt 120 yards ?

16s. 9¼d.
12

201

£. s.
2)201 5

100 12 6 *Anſ.*

To find the price of one, at ſo much per hundred of 6 *ſcore.*

RULE. Multiply the price by 2, then call the pound ſo many pence, and the ſhillings, ſuch a part of a penny,

penny, as they are of a pounds, and you will have the anſwer.

24. If 120 yards coſt 3l. 12s.; what coſt 1 yard?

£.	s.
3	12
	2
7	4

Anſ. 7$\frac{1}{5}$d.

25. If 120 yards coſt 5l. 18s. 6d.; what coſt 1?

£.	s.	d.
5	18	6
		2
11	17	0

Anſ. 11$\frac{3}{4}$d + $\frac{2}{3}$ of a farth.

TABLE of Aliquot parts. 120 the Integer.

Alſo,

6 is	$\frac{1}{20}$	24 is	$\frac{1}{5}$	36 is	$\frac{3}{10}$	72 is	$\frac{3}{5}$	96 is	$\frac{4}{5}$
10 —	$\frac{1}{12}$	30 —	$\frac{1}{4}$	45 —	$\frac{3}{8}$	75 —	$\frac{5}{8}$	100 —	$\frac{5}{6}$
12 —	$\frac{1}{10}$	40 —	$\frac{1}{3}$	48 —	$\frac{2}{5}$	80 —	$\frac{2}{3}$	105 —	$\frac{7}{8}$
15 —	$\frac{1}{8}$	60 —	$\frac{1}{2}$	50 —	$\frac{3}{12}$	84 —	$\frac{7}{10}$	108 —	$\frac{9}{10}$
20 —	$\frac{1}{6}$	—		70 —	$\frac{7}{12}$	90 —	$\frac{3}{4}$	110 —	$\frac{11}{12}$

26. At 3l. 17s. 6d. per hundred; what coſt 14;

		£.	s.	d.	
12	$\frac{1}{10}$	3	17	6	
		0	7	9	} *Add.*
2	$\frac{1}{6}$	0	1	3$\frac{1}{2}$	}
14	=	£0	9	0$\frac{1}{2}$	*Anſ.*

27. At 1l. 19s. 3d. per hundred what coſt 75?

£.	s.	d.
1	19	3
		5
8)9	16	3
£1	4	6$\frac{1}{4}$

Anſ.

VI. *To*

VI. *To find the value of goods ſold by the Great Groſs.*

Note. 12 make 1 dozen, 12 dozen 1 ſmall groſs, 12 ſmall groſs 1 great groſs.

The price of 1 dozen being given in pence, to find the price of a great groſs.

RULE. Multiply the price of 1 dozen, in pence, by 3, then divide that product by 5, and the quotient will be the anſwer in pounds, &c.

For proof, do the contrary.

N. B. If the price of 1 be given, the price of 1 ſmall groſs is found after the ſame manner.

28. At 18d. per dozen; what coſt 1 great groſs?

18d.
3
5)54
£10 16 *Anſ.*

29. At 4s. 3d. per dozen; what coſt 1 great groſs?

4s. 3d.	Or,
12	s. d.
51d.	4 3
3	12
5)153	2 11 0
	12
Anſ. £30 12	£30 12 0

TABLE of Aliquot parts. 144 the Integer.

Alſo.

12 is $\frac{1}{12}$	36 is $\frac{1}{4}$	32 is $\frac{2}{9}$	84 is $\frac{7}{12}$	128 is $\frac{8}{9}$			
16 — $\frac{1}{9}$	48 — $\frac{1}{3}$	60 — $\frac{5}{12}$	96 — $\frac{2}{3}$	132 — $\frac{11}{12}$			
18 — $\frac{1}{8}$	72 — $\frac{1}{2}$	64 — $\frac{4}{9}$	108 — $\frac{3}{4}$				
24 — $\frac{1}{6}$		80 — $\frac{5}{9}$	120 — $\frac{5}{6}$				

30. What

30. What coſt 117 dozen, at 9l. 13s. 7d. per great groſs?

£.	s.	d.	
9	13	7	
		3	
29	0	9	
7	5	$2\frac{1}{4}$	Add.
0	12	$1\frac{1}{4}$	Add.

Doz. 108 | $\frac{1}{4}$ | 9 | $\frac{1}{12}$ | 117 = £7 17 $3\frac{1}{2}$ *Anſ.*

31. At 3l 16s. 8d per great groſs; what coſt 7 great groſs, and 96 dozen?

£.	s.	d.	
3	16	8	
		2	
3)7	13	4	
96 =	2	11	$1\frac{1}{4}$
7 =	26	16	8
£29	7	$9\frac{1}{4}$	

Top line ×

VII. *To find the value of goods ſold by the Thouſand.*

The price of 1 is given to find the price of 1000.

Rule. Multiply the given price in pence, by 50; then divide the product by 12, and the quotient will be the anſwer in pounds, &c.

32. At 6d. each; what coſt 1000?

6
50
12)300
£25 *Anſ.*

Or, as 1000s. are 50l.; take parts for the pence, out of 50.

6d.	$\frac{1}{2}$	50
		25 *Anſ.*

To find the price of *one*, at ſo much per thouſand.

RULE. Multiply the price by 12; divide the product by 50; then take the pounds for ſo many pence, and the ſhillings for ſuch a part of a penny as they are of a pound, which will be the anſwer.

33. At 354l. 3s. 4d. per 1000; what coſt 1?

£.	s.	d.
354	3	4
		12
10)4250	0	0
5)425		
85		

Anſ. 7s. 1d.

Or,

		£.	s.	d.
100	$\frac{1}{10}$	354	3	4
10	$\frac{1}{10}$	35	8	4
1	$\frac{1}{10}$	3	10	10
	Anſ.	7	1	

TABLE of Aliquot parts. 1000 the Integer.

				Alſo,			
50 is	$\frac{1}{20}$	200 is	$\frac{1}{5}$	300 is	$\frac{3}{10}$	700 is	$\frac{7}{10}$
100 —	$\frac{1}{10}$	250 —	$\frac{1}{4}$	375 —	$\frac{3}{8}$	750 —	$\frac{3}{4}$
115 —	$\frac{1}{8}$	500 —	$\frac{1}{2}$	400 —	$\frac{2}{5}$	800 —	$\frac{4}{5}$
				600 —	$\frac{3}{5}$	875 —	$\frac{7}{8}$
				625 —	$\frac{5}{8}$	900 —	$\frac{9}{10}$

34. At 1l. 17s. 9d. per 1000; what coſt 115?

		£.	s.	d.
100	$\frac{1}{10}$	1	17	9
10	$\frac{1}{10}$	0	3	$9\frac{1}{4}$
		0	0	$4\frac{1}{2}$
5	$\frac{1}{8}$	0	0	$2\frac{1}{4}$
115	=	0	4	4 Anſ.

Add.

35. At 2l. 1s. 8d. per 1000; what coſt 875?

£.	s.	d.
2	1	8
		7
8)14	11	8
1	16	$5\frac{1}{2}$ Anſ.

BILL.

BILL OF PARCELS.

Newburyport, January 1ſt, 1793.

Mr. Timothy Huckſter

Bought of *Samuel Merchant*,

25½lb. Bohea tea, at 3s. 6d. per lb.
48lb. cheeſe, at 9d. per lb.
15 pair of worſted hoſe, at 5s. 8d per pair.
4½ dozen women's gloves, at 36s. 6d. per dozen.
19 dozen knives and forks, at 5s. 9d per dozen.
9 grindſtones, at 15s. 9d. per ſtone.
½ cwt. brown ſugar at 51s per cwt.
31lb. loaf ſugar, at 1s. ½d. per lb.

£34 3 3½

Received payment in full,

Samuel Merchant

TARE AND TRET.

Tare and Tret are practical rules for deducting certain allowances, which are made by merchants and tradeſman in ſelling their goods by weight.

Tare is an allowance made to the buyer, for the weight of the box, barrel or bag, &c. which contains the goods bought, and is either at ſo much per box, &c. at ſo much per cwt. or at ſo much in the groſs weight.

Tret is an allowance of 4lb. in every 104lb for waſte, duſt, &c.

Cloff is an allowance of 2lb. upon every 3cwt.

Groſs weight is the whole weight of any ſort of goods, together with the box, barrel or bag, &c. which contains them.

Suttle is when part of the allowance is deducted from the groſs.

Neat weight is what remains after all allowances are made.

CASE.

CASE I*.

When the tare is at ſo much per box, barrel or bag, &c.--Multiply the number of boxes, barrels, &c by the tare, and ſubtract the product from the groſs, and the remainder will be the neat weight required.

EXAMPLES.

1. In 6 hogſheads of ſugar, each weighing 9cwt. 2qrs. 10lb. groſs, tare 25lb per hogſhead; how much neat.

	Cwt.	qr.	lb.		Cwt.	qr.	lb.	
25 × 6 =	1	1	10		9	2	10	groſs weight of 1 hhd.
							6	
					57	2	4	groſs.
					1	1	10	tare.
				Anſ.	56	0	22	neat.

2. In 5 bags of cotton, marked with the groſs weight as follows, tare 23lb. per bag; what neat weight?

	Cwt.	qrs.	lb.
A =	7	1	19
B =	3	3	27
C =	5	1	12
D =	6	0	15
E =	8	1	0

	Cwt.	qrs.	lb.	
Anſ.	30	0	14	neat.

3. What is the neat weight of 15 hogſheads of tobacco, each 7cwt. 1qr. 13lb. tare 100lb. per hdd.?

Anſ. 97cwt. 0qr. 11lb.

CASE

* This, as well as every other Caſe in this rule, is only an appl ication of the rules of Proportion and Practice.

CASE II.

When the tare is at ſo much per cwt.—Divide the groſs weight by the aliquot parts of a cwt. Subtract the quotient from the groſs, and the remainder will be the neat weight.

Examples.

1. In 129cwt. 3qrs. 16lb. groſs; tare 14lb. per cwt. what neat weight?

lb.		Cwt.	qrs.	lb.	
14	$\frac{1}{8}$	129	3	16	groſs.
		16	0	$26\frac{1}{2}$	tare.
	Anſ.	113	2	$17\frac{1}{2}$	neat.

2. In 97cwt. 1qr. 7lb. groſs; tare 20lb. per cwt. what neat weight?

lb.		Cwt.	qrs.	lb.	
16	$\frac{1}{4}$	97	1	7	groſs.
4	$\frac{1}{4}$	13	3	17	} *Add.*
		3	1	25	}
Subtract		17	1	14	tare.
Anſ.		79	3	21	neat.

3. What is the neat weight of 4 barrels of pot-aſh, each weighing 305lb. groſs; tare 12lb. per cwt.?

Anſ. 2450lb. 14oz. 5drs.

CASE III.

When the tret is allowed with tare;—Divide the ſuttle weight by 26, and the quotient will be the tret, which ſubtract from the ſuttle and the remainder will be the neat.

Examples.

Examples.

1. In 247cwt. 2qrs. 15lb. groſs; tare 28 per cwt. and tret 4lb. per 104lb.; what neat weight?

lb.		Cwt.	qrs.	lb.	
28	$\frac{1}{4}$	247	2	15	groſs.
		61	3	17	12 tare, ſubtract.
4	$\frac{1}{28}$	185	2	25	4 ſuttle.
		7	0	16	0 tret, ſubtract.
		Anſ. 178	2	9	4 neat.

2. What is the neat weight of 4hhds. of tobacco, weighing as follows; the 1ſt, 5cwt. 1qr 12lb. groſs; tare 65lb. per hogſhead; 2d, 3cwt. 0qr. 14lb. groſs; tare 75lb.; the 3d 6cwt. 3qrs. groſs; tare 49lb.; and the 4th, 4cwt. 2qrs 9lb. groſs; tare 35lb. and allowing tret to each as uſual? *Anſ.* 17cwt. 0qr. 19lb.

CASE IV.

When tare, tret and cloff are allowed;—Deduct the tare and tret as before, and divide the ſuttle by 168, and the quotient will be the cloff, which ſubtract from the ſuttle, and the remainder will be the neat.

Examples.

1. What is the neat weight of a hogſhead of tobacco, weighing 16cwt. 2qrs. 20lb. groſs; tare 14lb. per cwt. tret 4lb. per 104, and cloff 2lb. per 3cwt.?

	Cwt	qrs.	lb.	oz.	
14lb. is $\frac{1}{8}$	16	2	20	0	groſs.
	2	0	9	8	tare, ſubtract.
4lb. is $\frac{1}{28}$	14	2	10	8	
	0	2	6	13	tret, ſubtract.
2lb. is $\frac{1}{168}$	14	0	3	11	ſuttle.
	0	0	9	5	cloff, ſubtract.
	Anſ. 13	3	22	6	neat.

2. If

2. If 9hhds. of tobacco, contain 85cwt. oqr. 2lb. tare, 3olb. per hhd. tret and cloff as uſual; what will the neat weight come to, at $6\frac{1}{2}$d per lb. after deducting, for duties and other charges, 51l. 11s. 8d. ?

Anſ. 187l. 18s. 5d.

INVOLUTION,

OR, TO RAISE POWERS.

A Power is the product ariſing from multiplying any given number into itſelf continually a certain number of times, thus:

$3 \times 3 = 9$ is the 2d power, or ſquare of $3. = 3^2$

$3 \times 3 \times 3 = 27$ is the 3d power or cube of $3. = 3^3$

$3 \times 3 \times 3 \times 3 = 81$ is the 4th power, or the biquadrate of 3, &c. $= 3^4$

The number denoting the power is called the Index, or the Exponent of that power; thus, the ſecond power of 5 is 25, or 5^2, &c.

$2 \times 2 = 4$, the ſquare of 2: $4 \times 4 = 16 = 4$th power of 2: $16 \times 16 = 256 = 8$th power of 2, &c.

Rule. Multiply the given number, root, or firſt power continually by itſelf, till the number of multiplications be one leſs than the index of the power to be found, and the laſt product will be the power required.

Note. Whence, becauſe fractions are multiplied by taking the products of the numerators, and of their denominators, they will be involved by raiſing each of their terms to the power required; and if a mixed number be propoſed, either reduce it to an improper fraction, or reduce the vulgar fraction to a decimal, and proceed by the rule.

A TABLE OF POWERS.

Roots,	1	2	3	4	5	6	7	8	9
Squares,	1	4	6	16	25	36	49	64	81
Cubes,	1	8	27	64	125	216	343	512	729
Biquadrates,	1	16	81	256	625	1296	2401	4096	6561
Surfolids,	1	32	243	1024	3125	7776	16807	32768	59049
Square Cubes,	1	64	729	4096	15625	46656	117649	262144	531441
Second Surfolids,	1	128	2187	16384	78125	279936	823543	2097152	4782969
Biquadrates, Squared;	1	256	6561	65536	390625	1679816	5764801	16777216	43046721
Cubes, Cubed;	1	512	19683	262144	1953125	10077696	40353607	134217728	387420489
Surfolids, Squared;	1	1024	59049	1048576	9765625	60466176	282475249	1073741824	4386784401
Third Surfolids,	1	2048	177147	4194304	48828125	362797056	1977326743	8589934592	39381659609
Square Cube, Squared;	1	4096	531441	16777216	244140625	2176782336	13841287201	68719476736	282429536481

Examples.

1. What is the 5th power of 9?

9
9
81 = 2d power.
9
729 = 3d power.
9
6561 = 4th power.
9
59049 = 5th power.
or *Anf.* = 9^5.

2. What is the 5th power of $\frac{3}{5}$? *Anf.* $\frac{243}{3125}$.

3. What is the 4th power of ,045?
Anf. ,000004100625.

Here we ſee, that in raiſing a fraction to a higher power, we decreaſe its value.

EVOLUTION,

or, *the* Extraction *of* ROOTS.

The Root is a number whoſe continual multiplication into itſelf produces the power, and is denominated the ſquare, cube, biquadrate, or 2d, 3d, 4th root, &c. accordingly, as it is, when raiſed to the 2d, 3d, 4th, &c. power, equal to that power. Thus, 4 is the ſquare root of 16; becauſe $4 \times 4 = 16$, and 3 is the cube root of 27, becauſe $3 \times 3 \times 3 = 27$; and ſo on.

Although there is no number of which we cannot find any power exactly, yet there are many numbers, of which preciſe roots can never be determined. But by the help of decimals, we can approximate towards the root, to any aſſigned degree of exactneſs.

The roots, which approximate, are called *surd roots*; and those which are perfectly accurate, are called *rational roots*.

Roots are sometimes denoted by writing the character $\surd$ before the power, with the index of the root over it; thus the 3d root of 36 is expressed $\sqrt[3]{36}$, and the 2d root of 36 is $\surd 36$, the index 2 being omitted when the square root is designed.

If the power be expressed by several numbers, with the sign + or — between them, a line is drawn from the top of the sign over all the parts of it; thus,

the 3d root of 47 + 22 is $\sqrt[3]{47+22}$, and the 2d root of 59 — 17 is $\surd 59-17$, &c.

Sometimes roots are designed like powers, with fractional indices; thus, the square root of 15 is $15^{\frac{1}{2}}$, the cube root of 21 is $21^{\frac{1}{3}}$, and the fourth root of $37-20$ is $37-20^{\frac{1}{4}}$, &c.

The EXTRACTION *of the* SQUARE ROOT.

RULE 1.—Distinguish the given number into periods of two figures each, by putting a point over the place of units, another over the place of hundreds, and so on, which points shew the number of figures the root will consist of.

2. Find the greatest square number in the first, or left hand period, place the root of it at the right hand of the given number, (after the manner of a quotient in division) for the first figure of the root, and the square number, under the period, and subtract it therefrom, and to the remainder bring down the next period for a dividend.

3. Place the double of the root, already found, on the left hand of the dividend for a divisor.

4. Seek

4. Seek how often the diviſor is contained in the dividend, (except the right hand figure) and place the anſwer in the root for the ſecond figure of it, and likewiſe on the right hand of the diviſor: Multiply the diviſor, with the figure laſt annexed, by the figure laſt placed in the root, and ſubtract the product from the dividend: To the remainder join the next period for a new dividend.

5. Double the figure already found in the root, for a new diviſor, (or bring down your laſt diviſor for a new one, doubling the right hand figure of it) and from theſe find the next figure in the root as laſt directed; and continue the operation in the ſame manner, till you have brought down all the periods.

Note 1. If, when the given power is pointed off as the power requires, the left hand period ſhould be deficient, it muſt nevertheleſs ſtand as the firſt period.

Note 2. If there be decimals in the given number, it muſt be pointed both ways from the place of units; If when there are integers, the firſt period in the decimals be deficient, it may be completed by annexing ſo many cyphers as the power requires; And the root muſt be made to conſiſt of ſo many whole numbers and decimals as there are periods belonging to each; and when the periods belonging to the given number are exhauſted, the operation may be continued at pleaſure by annexing cyphers.

EXAMPLES.

1. Required the ſquare root of 30138696025?

30138696025(173665 the root.
1

1ſt Diviſor=27)201
189

2d Diviſor=343)1238
1029

3d Diviſor=3466)20969
20796

4th Diviſor=347305)1736025
1736025

2. Required

2. Required the ſquare root of 57555?

```
575,55(23,98 + root.
4
---
43)175
129
---
469)4650
4221
----
4788)42960
38304
-----
4596 remainder.
```

3. What is the ſquare root of 10342656?

Anſ. 3216.

4. What is the ſquare root of 964,51923604?

Anſ. 31,05671.

5. What is the ſquare root of ,00003169?

Anſ. ,00563.

Note. When more than half the root is found, the remaining figures of it may be found by Diviſion, making uſe of the laſt diviſor, and bringing down ſo many of the next figures of the reſolvend as there were periods to come down, when you began the diviſion.

RULES *for the* SQUARE ROOT *of* VULGAR FRACTIONS *and* MIXED NUMBERS.

After reducing the fraction to its loweſt terms, for this and all other roots; then,

1. Extract the *root* of the *numerator* for a *new numerator*, and the *root* of the *denominator* for a *new denominator*, which is the beſt method, provided the denominator be a complete power. But if it be not,

2. Multiply the numerator and denominator together; and the root of this product being made the numerator to the denominator of the given fraction, or made the denominator to the numerator of it, will form the fractional part required:—*Or*,

3. Reduce the vulgar fraction to a decimal, and extract its root.

4. Mixed numbers may either be reduced to improper fractions, and extracted by the firſt or ſecond rule;

rule; or the vulgar fraction may be reduced to a decimal, then joined to the integer, and the root of the whole extracted.

EXAMPLES.

1. What is the ſquare root of $\frac{144}{1681}$?

By Rule 1.

$\frac{144}{1681}=\frac{16}{1681}$ 16(4 root of the numerator.
16

1681(41 root of the denominator.
16

81)81 Therefore $\frac{4}{41}$=the root of the given fraction.
81

By Rule 2.

16 × 1681=26896 and $\sqrt{}$ 26896=164. Then,

$\frac{164}{1681}=\frac{16}{164}=\frac{4}{41}=$,09756+

By Rule 3.

1681)16(,00951814 39+. And $\sqrt{}$,00951814 39=,09756+.

2. What is the ſquare root of $\frac{3701}{12006}$? *Anſ.* $\frac{7}{12}$.

3. What is the ſquare root of $42\frac{1}{4}$? *Anſ.* $6\frac{1}{2}$.

Note. In extracting the ſquare or cube root of any ſurd number there is always a remainder or fraction left, when the root is found: To find the value of which, the common method is to annex pairs of cyphers to the reſolvend, for the ſquare, and ternaries of cyphers to that of the cube, which makes it tedious to diſcover the value of the remainder, eſpecially in the cube. Now this trouble may be ſaved by the following method.

In the ſquare the quotient is always doubled for a new diviſor: Therefore when the work is completed, the root doubled is the true diviſor, or denominator* to its own fraction; as, if the root be 12, the denominator will

* Theſe denominators give a ſmall matter too much in the ſquare root, and too little in the cube, yet they will be ſufficient in common uſe.

will be 24; to be placed under the remainder; which vulgar fraction, or its equivalent decimal, muſt be annexed to the quotient, or root, to complete it.

If to the remainder either of the ſquare or cube, cyphers be annexed, and divided by their reſpective denominators, the quotient will produce the decimals belonging to the root.

APPLICATION AND USE OF THE SQUARE ROOT.

PROBLEM I. *To find a mean proportional between two numbers.*

RULE. Multiply the given numbers together, and extract the ſquare root of the product; which root will be the mean proportional ſought.

EXAMPLES.

What is the mean proportional between 24 and 96?

$\sqrt{96 \times 24} = 48$ *Anſ.*

PROBLEM II. *To find the ſide of a* Square *equal in* Area *to any given* Superficies *whatever.*

RULE. Find the *Area*, and the ſquare root is the ſide of the ſquare ſought.

EXAMPLES.

1. If the area of a circle be 184,125; what is the ſide of a ſquare equal in area thereto?

$\sqrt{184,125} = 13,569+$ *Anſ.*

2. If the area of a triangle be 160; what is the ſide of a ſquare equal in area thereto?

$\sqrt{160} = 12,649+$ *Anſ.*

PROB.

PROB. III. A certain General has an army of 5625 men; pray how many muſt he place in rank and file, to form them into a ſquare?

$\sqrt{5625}=75$ *Anſ.**

PROB. IV. Let 10952 men be ſo formed, as that the number in rank may be double the file.

$\sqrt{\frac{10952}{2}}=74$ in file, and $74\times 2=148$ in rank.

PROB. V. If it be required to place 2016 men ſo as that there may be 56 in rank and 36 in file, and to ſtand 4 feet diſtance in rank, and as much in file; how much ground do they ſtand on?

To anſwer this, or any of the kind, uſe the following proportion:—As unity: to the diſtance :: ſo is the number in rank leſs by one: to a fourth number;—next do the ſame by the file, and multiply the two numbers together, found by the above proportion, and the product will be the anſwer.†

As $1:4::56-1:220$. And as $1:4::36-1:140$. Then $220\times 140=30800$ ſquare feet, the *Anſ.*

PROB. VI. Suppoſe I would ſet out an orchard of 600 trees, ſo that the length ſhall be to the breadth, as 3 to 2, and the diſtance of each tree, one from the other, 7 yards; how many trees muſt it be in length, and how many in breadth; and how many ſquare yards of ground do they ſtand on?

To

* If you would have the number of men be double, triple, or quadruple, &c. as many in rank as in file; extract the ſquare root of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c. of the given number of men, and that will be the number of men in file, which double, triple, quadruple, &c. and the product will be the number in rank.

† The above rule will be found uſeful in planting trees, having the diſtance of ground between each given.

To reſolve any queſtion of this nature; ſay, as the ratio in length: is to the ratio in breadth :: ſo is the number of trees: to a fourth number; whoſe ſquare root is the number in breadth; And as the ratio in breadth: is to the ratio in length :: ſo is the number of trees: to a fourth, whoſe root is the number in length.

As 3 : 2 :: 600 : 400. And $\sqrt{400}=20$=number in breadth.

As 2 : 3 :: 600 : 900. And $\sqrt{900}=30$=number in length.

As 1 : 7 :: 30—1 : 203. And as 1 : 7 :: 20—1 : to 133. And $203\times133=26999$ ſquare yards the *Anſwer.*

Prob. VII. Admit a leaden pipe $\frac{3}{4}$ inch diameter will fill a ciſtern in 3 hours; I demand the diameter of another pipe, which will fill the ſame ciſtern in 1 hour.

Rule. As the given time is to the ſquare of the given diameter, ſo is the required time to the ſquare of the required diameter. $\frac{3}{4}=,75$; and $,75\times,75=5625$: Then, as 3h. : ,5625 :: 1h. : 1,6875 inverſely, and $\sqrt{1,6875}=1,3$ inch nearly, *Anſwer.*

Prob. VIII. If a pipe, whoſe diameter is 1,5 inch, fill a ciſtern in 5 hours; in what time will a pipe, whoſe diameter is 3,5 inches fill the ſame?

$1,5\times1,5=2,25$; and $3,5\times3,5=12,25$: Then, as 2,25 : 5 :: 12,25 : ,91 hour inverſely, =54 minutes 39 ſeconds *Anſ.*

Prob. IX. If a pipe 6 inches bore, will be 4 hours in running off a certain quantity of water; in what time will 3 pipes, each 4 inches bore, be in diſcharging double the quantity?

$6\times6=36$, $4\times4=16$, and $16\times3=48$. Then, as 36 : 4h. :: 48 : 3h. inverſely, and as 1w. : 3h. :: 2w. : 6h. *Anſwer.*

Prob.

PROB. X. Given the diameter of a circle to make another circle, which ſhall be 2, 3, 4, &c. times greater or leſs than the given circle.

RULE.—Square the given diameter, and if the required circle be greater, multiply the ſquare of the diameter by the given proportion, and the root of the product will be the required diameter;—But if the required circle be leſs; divide the ſquare of the diameter by the given proportion, and the root of the quotient will be the diameter required.

There is a circle, whoſe diameter is 4 inches; I demand the diameter of a circle 3 times as large?

$4 \times 4 = 16$; and $16 \times 3 = 48$; and $\sqrt{48} = 6,928+$ inches, *Anſwer.*

PROB. XI. To find the diameter of a circle equal in area to an ellipſis (or oval) whoſe tranſverſe and conjugate diameters are given.*

RULE.—Multiply the two diameters of the ellipſis together; and the Square Root of that product will be the diameter of a circle equal to the ellipſis.

Let the tranſverſe diameter of an ellipſis be 48, and the conjugate 36; What is the diameter of an equal circle?

$48 \times 36 = 1728$, and $\sqrt{1728} = 41,569+$ the *Anſ.*

PROB. XII. Two ſhips ſail from the ſame port; one goes due north 45 leagues, and the other due weſt 76 leagues: How far are they aſunder?

$45 \times 45 = 2025$. $76 \times 76 = 5776$. Then $5776 \times 2025 = 7801$, and, $\sqrt{7801} = 88,32$ leagues, the *Anſ.*

EXTRACTION

* The tranſverſe and conjugate are the longeſt and ſhorteſt diameters of an ellipſis; they paſs through the centre, and croſs each other at right angles

EXTRACTION *of the* CUBE ROOT.

A Cube, is any number multiplied by its ſquare. To extract the cube root, is to find a number which being multiplied into its ſquare, ſhall produce the given number.

FIRST METHOD.

RULE 1.—Separate the given number into periods of three figures each, by putting a point over the unit figure and every third figure beyond the place of units.

2. Find the greateſt cube in the left hand period, and put its root in the quotient.

3. Subtract the cube, thus found, from the ſaid period, and to the remainder bring down the next period, and call this the dividend.

4. Multiply the ſquare of the quotient by 300, calling it the triple ſquare, and the quotient by 30, calling it the triple quotient, and the ſum of theſe call the diviſor.

5. Seek how often the diviſor may be had in the dividend, and place the reſult in the quotient.

6. Multiply the triple ſquare by the laſt quotient figure, and write the product under this dividend; multiply the ſquare of the laſt quotient figure by the triple quotient, and place this product under the laſt; under all, ſet the cube of the laſt quotient figure, and call their ſum the ſubtrahend.

7. Subtract the ſubtrahend from the dividend, and to the remainder bring down the next period for a new dividend, with which proceed as before, and ſo on till the whole be finiſhed.

Note. The ſame rule muſt be obſerved for continuing the operation and pointing for decimals, as in the ſquare root.

EXAMPLES.

EXAMPLES.

1. Required the cube root of 43603682428 7 ?

43602682428 7(7583 the root.
343

1ſt Diviſor=14910)93036=1ſt Dividend.

73500
5250
125

78875=1ſt Subtrahend.

2d Diviſor=1687750)14161824=2d Dividend.

23500000
144000
512

13644512=2d Subtrahend.

3d Diviſor=172391940)517312287=3d Dividend.

517107600
204660
27

517312287=3d Subtrahend

.....

The Method of Operation.

3×7×300= 14700=1ſt Triple ſquare.
7×30 = 210=1ſt Triple quotient.

14910=1ſt Diviſor.

14700×5= 73500
5×5×210= 5250
5×5×5 = 125

78875 = 1ſt Subtrahend.

Carried over.

Brought over.

75175×300 = 1687500 = 2d Triple ſquare.
75×30 = 2250 = 2d Triple Quotient.

1689750 = 2d Diviſor.

1687500×8 = 13500000
225×8×8 = 144000
8×8×8 = 512

13644512 = 2d Subtrahend.

758×758×500 = 172369200 = 3d Triple Square.
758×30 = 22740 = 3d Triple Quotient.

172391940 = 3d Diviſor.

172369200×3 = 517107600
22740×3×3 = 204660
3×3×3 = 27

517312287 = 3d Subtrahend.

2. What is the cube root of 34965783 ?

Anſ. 327.

3. What is the cube root of 84,604519 ?

Anſ. 4,39.

4. What is the cube root of ,008649 ?

Anſ. ,2052+.

5. What is the cube root of $\frac{125}{343}$?

Anſ. $\frac{5}{7}$.

To find the true denominator, to be placed under the remainder, after the operation is finiſhed.

In the extraction of the cube root, the quotient is ſaid to be ſquared and tripled for a new diviſor : But is not really ſo, till the triple number of the quotient be added to it ; therefore, when the operation is finiſhed, it is but ſquaring the quotient, or root, then multiplying it by 3, and to that number adding the triple number of the root, when it will become

become the divisor, or true denominator to its own fraction, which fraction must be annexed to the quotient, to complete the root.

Suppose the root to be 12, when squared it will be 144, and multiplied by 3, it makes 432, to which add 36, the triple number of the root, and it produces 468 for a denominator.

SECOND METHOD.

RULE 1. Having pointed the given number into periods of three figures each, find the greatest cube in the left hand period, subtracting it therefrom, and placing its root in the quotient; to the remainder bring down the next period, and call it the *dividend.*

2. Under this dividend write the triple square of the root, so that units in the latter may stand under the place of hundreds in the former; and under the said triple square, write the triple root, removed one place to the right hand, and call the sum of these the *divisor.*

3. Seek how often the divisor may be had in the dividend, exclusive of the place of units, and write the result in the quotient.

4. Under the divisor write the product of the triple square of the root by the last quotient figure, setting down the unit's place of this line, under the place of tens in the divisor; under this line, write the product of the triple root by the square of the last quotient figure, so as to be removed one place beyond the right hand figure of the former; and, under this line, removed one place forward to the right hand, write down the cube of the last quotient figure, and call their sum the *subtrahend.*

5. Subtract the subtrahend from the dividend, and to the remainder bring down the next period for a new

dividend, with which proceed as before, and ſo on, till the whole be finiſhed.

EXAMPLE.

Required the Cube Root of 16194277?

16194277(253=Root.
8

8194 = Firſt dividend.

12 = Triple ſquare of 2.
6 = Triple of 2.

126 = Firſt diviſor.

60 = Triple ſquare of 2 multiplied by 5.
150 = Triple of 2 multiplied by the ſquare of 5.
125 = Cube of 5.

7625 = Firſt ſubtrahend.

569277=Second dividend.

1875 = Triple ſquare of 25.
75 = Triple of 25.

18825 = Second diviſor.

5625 = Triple ſquare of 25 multiplied by 3.
675 = Triple of 25 multiplied by ſquare of 3.
27 = Cube of 3.

569277 = Second ſubtrahend.

FIRST METHOD BY APPROXIMATION.

RULE 1. Find by trial, a cube near to the given number, and call it the *ſuppoſed* cube.

2. Then,

2. Then, as twice the *fuppofed* cube, added to the given number, is to twice the given number, added to the *fuppofed* cube, fo is the root of the *fuppofed* cube, to the true root, or an approximation to it.

3. By taking the cube of the root, thus found, for the *fuppofed* cube, and repeating the operation, the root will be had to a greater degree of exactnefs.

EXAMPLE.

It is required to find the cube root of 54854153? Let 64000000=*fuppofed* cube, whofe root is 400;

Then 64000000 × 2 = 128000000; 54854153 × 2 = 109708306

128000000 + 54854153 = 182854153; 109708306 + 64000000 = 173708306

As 182854153 : 173708306 :: 400 : 400

182854153)69483321400(379=*root nearly.*

Again, let 54439939=*fuppofed* cube, whofe root is 379.

Then, 54439939 × 2 = 108879878; 54854153 × 2 = 109708306

108879878 + 54854153 = 163734031; 109708306 + 54439939 = 164148245

As 163734031 : 164148245 :: 379 : 379

1477334205
1149037715
492444735

163734031)62212184855(379,958793 ×
(=*Root correct.*

SECOND.

SECOND METHOD BY APPROXIMATION.

RULE 1. Divide the reſolvend by three times the aſſumed root, and reſerve the quotient.

2. Subtract one twelfth part of the ſquare of the aſſumed root from the quotient.

3. Extract the ſquare root of the remainder.

4. To this root add one half of the aſſumed root, and the ſum will be the true root, or an approximation to it; —Take this approximation as the aſſumed root, and, by repeating the proceſs, a root farther approximated will be found, which operation may be farther repeated as often as neceſſary, and the root diſcovered to any aſſigned exactneſs.

NOTE. In order to find the value of the firſt aſſumed root, in this or any other power, divide the reſolvend into periods, by beginning at the place of units, and including in each period, ſo many figures as there are units in the exponent of the root; viz 3 figures in the cube root; 4 for the biquadrate, and ſo on: Then by a table of powers, or otherwiſe, find a figure, which, (being involved to the power whoſe exponent is the ſame with that of the required root) is the neareſt to the value of the firſt period of the reſolvend at the left hand; and to that figure annex ſo many cyphers as there are periods remaining in the integral part of the reſolvend; this figure, with the cyphers annexed, will be the aſſumed root: And it is of no importance whether the figure thus choſen, be, when involved, greater or leſs than the left hand period.

1. What is the cube root of 4360368 24287?

7000=aſſumed root.

8

21,000)436036824287(20763658,2994

Subtr. 7000 × 7000 ÷ 12 = 4083333,3333

$\sqrt{}$ 16680324,9661 = 4084,15

Add ½ *the aſſumed root*, = 3500

And it gives the approximated root = 7584,15.

For

For the ſecond operation, uſe the approximated root as the aſſumed one, and proceed as above.

THIRD METHOD BY APPROXIMATION.

1. Aſſume the root in the uſual way, then multiply the ſquare of the aſſumed root by 3, and divide the reſolvend by this product; to this quotient add $\frac{2}{3}$ of the aſſumed root, and the ſum will be the true root, or an approximation to it.

2. For each ſucceeding operation let the laſt approximated root be the aſſumed root, and proceeding in this manner, the root may be extracted to any aſſigned exactneſs.

What is the cube root of 7?

Let the aſſumed root be 2. Then $\overline{2\times2\times3}=12$ the diviſor.

12)7,0(,583, to this add $\frac{2}{3}$ of 2=1,333, &c. that is, 583+1,333=1,916 approximated root.

Now aſſume 1,916 for the root, then, by the ſecond proceſs, the root is $\frac{7}{3\times1,916}$——$\overline{2+\frac{2}{3}\times1,916}$=1,9126, &c.

APPLICATION AND USE OF THE CUBE ROOT.

1. To find *two* mean proportionals between any two given numbers.

Rule 1. Divide the *greater* by the *leſs*, and extract the cube root of the quotient.

2. Multiply the root, ſo found, by the leaſt of the given numbers, and the product will be the *leaſt*.

3. Multiply this product by the ſame root, and it will give the greateſt.

Examples.

1. What are the two mean proportionals between 6 and 750?

$750 \div 6 = 125$, and $\sqrt[3]{125} = 5$. Then $5 \times 6 = 30$ = leaſt, and $30 \times 5 = 150$ = greateſt. *Anſ.* 30 and 150.

Proof. As 6 : 30 :: 150 : 750.

2. What are the two mean proportionals between 56 and 19208? *Anſ.* 392 and 2744.

Note. The ſolid contents of ſimilar figures are in proportion to each other, as the cubes of their ſimilar ſides or diameters.

3. If a bullet 6 inches diameter weigh 32lb.; what will a bullet of the ſame metal weigh, whoſe diameter is 3 inches?

$6 \times 6 \times 6 = 216$. $3 \times 3 \times 3 = 27$. As 216 : 32lb. :: 27 : 4lb. *Anſ.*

4. If a globe of ſilver of 3 inches diameter, be worth £45, what is the value of another globe of a foot diameter?

$3 \times 3 \times 3 = 27$. $12 \times 12 \times 12 = 1728$. As 27 : 45 :: 1728 : £2880 *Anſ.*

The ſide of a cube being given, to find the ſide of that cube which ſhall be double, triple, &c. in quantity to the given cube.

Rule. Cube your given ſide, and multiply it by the given proportion between the given and required cube, and the cube root of the product will be the ſide ſought.

5. If a cube of ſilver, whoſe ſide is 4 inches, be worth £50, I demand the ſide of a cube of the like ſilver, whoſe value ſhall be 4 times as much?

$4 \times 4 \times 4 = 64$, and $64 \times 4 = 256$. $\sqrt[3]{256} = 6,349 \times$ inches. *Anſwer.*

6. There is a cubical veſſel, whoſe ſide is 2 feet; I demand the ſide of a veſſel, which ſhall contain three times as much?

$2 \times 2 \times 2 = 8$, and $8 \times 3 = 24$. $\sqrt[3]{24} = 2,884 = 2$ feet, $10\frac{3}{5}$ inches, *Anſwer.*

7. The

7. The diameter of a bushel measure being $18\frac{1}{2}$ inches, and the height 8 inches; I demand the side of a cubick box, which shall contain that quantity?

Ans. 12,908 inches.

8. Suppose a ship of 500 tons has 89 feet keel, 36 feet beam, and is sixteen feet deep in the hold; what are the dimensions of a ship of 200 tons, of the same mould and shape?

$89 \times 89 \times 89 = 704969$ = cubed keel.

As 500 : 200 :: 704969 : 281987,6 cube of the required keel.

$\sqrt[3]{281987,6} = 65,57$ feet, the required keel.

As 86 : 65,57 :: 36 : $26,522 = 26\frac{1}{2}$ feet beam, nearly.

As 89 : 65,57 :: 16 : 11,7 feet, depth of the hold.

EXTRACTION OF THE BIQUADRATE ROOT.

RULE. Extract the square root of the resolvend, and then, the square root of that root, and you will have the biquadrate root.

What is the biquadrate root of 20736?

20736(144	144(12 root required.
1	1
24)107	22)44
96	44
284)1136	
1136	

BY APPROXIMATION.

METHOD I.

1. Divide the resolvend by *six* times the square of the assumed root, and from the quotient subtract $\frac{1}{16}$ part of the square of the assumed root.

2. Extract the square root of the remainder.

3. Add

3. Add $\frac{2}{3}$ of the assumed root to the square root, and the sum will be the true root, or an approximation to it.

4. For every succeeding operation (either in this or in the following method) proceed in the same manner as in the first, each time using the last approximated root for the assumed root.

The biquadrate root of 20736 is required.

Here, 10 *is the assumed Root.*

10X10X6=600)20736(34,56

Subtract, 10X10÷18= 5,5555

$\sqrt{29,0044}=5,38$

Add $\frac{2}{3}$ *of* 10=6,66

Approximated root 12,04, *to be made the assumed root for the next operation.*

METHOD 2.

Divide the resolvend by *four* times the cube of the assumed root: To the quotient add *three fourths* of the assumed root, and the sum will be the true root, or an approximation to it.

Let the biquadrate of 20736 be required, as before.

The assumed root is 10.

10X10X10X4=4000)20736(5,184

Add $\frac{3}{4}$ *of* 10=7,5

Approximated root 12,684, *to be made the assumed root for the next operation.*

EXTRACTION OF THE SURSOLID ROOT, BY APPROXIMATION.

A Particular RULE.

1. Divide the resolvend by *five* times the assumed root, and to the quotient add *one twentieth* part of the *fourth* power of the same root.

2. From

2. From the ſquare root of this ſum ſubtract *one fourth* part of the ſquare of the aſſumed root.

3. To the ſquare root of the remainder add *one half* of the aſſumed root, and the ſum is the root required, or an approximation to it.

NOTE This Rule will give the root true to *five* places, at the leaſt, (and generally to eight or nine places) at the firſt proceſs.

Required the Surſolid Root of 28195062 1875?

200 = *aſſumed root.*
5

1000 } 28195062 1,875 *quotient.*
Add 200 X 200 X 200 X 200 ÷ 20 } = 80000000

√ 361950621,875 = 19025 *nearly.*
Subtract, 200 X 200 ÷ 4 = 10000

√9025 = 95
Add half of the aſſumed root = 100

Root 195
(required.

A GENERAL RULE FOR EXTRACTING THE ROOTS OF ALL POWERS.

RULE* 1. Prepare the given number for extraction, by pointing off from the unit's place, as the required root directs.

2. Find

* The extracting of roots of very high powers will, by this rule, be a tedious operation:—The following method, when practicable, will be much more convenient.

When the index of the power, whoſe root is to be extracted, is a compoſite number, take any two or more indices, whoſe product is equal to the given index, and extract out of the given number a root anſwering to another of the indices, and ſo on to the laſt.

Thus, the fourth root = ſquare root of the ſquare root; the ſixth root = ſquare root of the cube root;—the eighth root = ſquare root of the fourth root;—the ninth root = the cube root of the cube root;—the tenth root = ſquare root of the fifth root;—the twelfth root = cube root of the fourth, &c.

2. Find the firſt figure of the root by trial, or by inſpection into the Table of Powers, and ſubtract its power from the left hand period.

3. To the remainder bring down the firſt figure in the next period, and call it the *dividend*.

4. Involve the root to the next inferiour power to that which is given, and multiply it by the number, denoting the given power, for a *diviſor*.

5. Find how many times the diviſor may be had in the dividend, and the quotient will be another figure of the root.

6. Involve the whole root to the given power, and ſubtract it from the *given number* as before.

7. Bring down the firſt figure of the next period to the remainder for a new dividend, to which find a new diviſor, as before, and, in like manner, proceed till the whole be finiſhed.

EXAMPLES.

1. What is the cube root of 20346417?

20346417(273

2^3 = 8 = 1ſt Subtrahend.

$2^2 \times 3$ = 12)122=Dividend.

27^3 = 19683=2d Subtrahend.

$27^2 \times 3$=2187)6634=2d Dividend.

273^3 = 20346417=3d Subtrahend.

. . . . .

The Method of Operation.

$2 \times 2 \times 2$=8 root of the firſt period, or 1ſt ſubtrahend.
2×2=4 (=next inferiour power) and,

4×3

4×3 (the index of the given power)=12, 1ſt diviſ.
27×27×27=19683=2d ſubtrahend.
27×27=229(next inferiour power) and,
729×3(=index of the given power)=2187=2d div.
273×273+273=20346417=3d ſubtrahend.

2. What is the biquadrate root of 34827998976?
Anſ. 431,9+.

OF PROPORTION IN GENERAL.

Numbers are compared together to diſcover the relations they have to each other.

There muſt be two numbers to form a compariſon: The number, which is compared, being written firſt, is called the *antecedent*; and that, to which it is compared, the *conſequent*.

Numbers are compared with each other two different ways: The one compariſon conſiders the *difference* of the two numbers, and is called Arithmetical Relation, the difference being ſometimes named the Arithmetical Ratio; and the other conſiders their *quotient*, which is termed Geometrical Relation, and the quotient, the Geometrical Ratio. Thus, of the numbers 12 and 4; the difference, or Arithmetical Ratio, is 12—4=8; and the Geometrical Ratio is $\frac{12}{4}=3$.*

If two, or more, couplets of numbers have equal ratios, or differences, the equality is termed proportion; and their terms ſimilarly proſited, that is, either all the greater, or all the leſs taken as antecedents, and the reſt as conſequents, are called proportionals. So, the two couplets, 2, 4, and 6, 8, taken thus, 2, 4, 6, 8, or thus, 4, 2, 8, 6, are arithmetical proportionals; and the two couplets,

* RATIOS are, here, always conſidered as the reſult of the greater term of compariſon diminiſhed, or divided by the leſs; not regarding which of them be the antecedent.

couplets 2, 4, and 8, 16, taken thus, 2, 4, 8, 16, or thus, 4, 2, 16, 8, are geometrical proportionals.*

Proportion is diſtinguiſhed into continual and diſcontinual. If, of ſeveral couplets of proportionals, written down in a ſeries, the difference or ratio of each conſequent, and the antecedent of the next following couplet, be the ſame as the common difference or ratio of the couplets, the proportion is ſaid to be continual, and the numbers themſelves, a ſeries of continual proportionals, or an arithmetical or geometrical proportion. So 2, 4, 6, 8, form an arithmetical proportion; for $4-2=6-4=8-6=2$; and, 2, 4, 8, 16, a geometrical proportion; for $\frac{4}{2}=\frac{8}{4}=\frac{16}{8}=2$.

NOTE. It is common to read the geometricals 2 : 4 :: 8 : 16: Thus, 2 is to 4 as 8 is to 16, or as 2 to 4 ſo is 8 to 16.

But if the difference or ratio of the conſequent of one couplet, and the antecedent of the next couplet be not the ſame as the common difference or ratio of the couplets, the proportion is ſaid to be diſcontinued. So 4, 2, 8, 6, are in diſcontinued arithmetical proportion; for $4-2=8-6=2$=common difference of the couplets, $8-2=6$=difference of the conſequent of one couplet and the antecedent of the next; alſo, 4, 2, 16, 8 are in diſcontinued geometrical proportion: For $\frac{4}{2}=\frac{16}{8}=2=$ common ratio of the couplets, and $\frac{16}{2}=8=$ ratio of the conſequent of one couplet and the antecedent of the next.

ARITHMETICAL

* Four numbers are ſaid to be *reciprocally* or *inverſely* proportional, when the fourth is leſs than the ſecond, by as many times as the third is greater than the firſt, or when the firſt to the third, is as the fourth to the ſecond, and *vice verſa*. Thus, 2, 9, 6 and 3 are reciprocal proportionals.

ARITHMETICAL PROPORTION.

THEOREM 1.—If any four quantities, 2, 4, 6, 8, be in Arithmetical Proportion, the ſum of the two means is equal to the ſum of the two extremes.

And if any three quantities, 2, 4, 6, be in Arithmetical Proportion, the double of the mean is equal to the ſum of the extremes.

THEOREM 2.—In any continued arithmetical proportion, 1, 3, 5, 7, 9, 11, the ſum of the two extremes, and that of every other two terms, equally diſtant from them, are equal: Thus, $1+11=3+9=5+7$.

When the number of terms is odd, as in the proportion, 3, 8, 13, 18, 23, then, the ſum of the two extremes, being double to the mean, or middle term, the ſum of any other two terms, equally remote from the extremes, muſt likewiſe be double to the mean.

THEOREM 3.—In any continued arithmetical proportion, $4, 4+2, 4+4, 4+6, 4+8$, &c. the laſt or greateſt term is equal to the firſt or leaſt more the common difference of the terms drawn into the number of all the terms after the firſt, or into the whole number of the terms, leſs one.

THEOREM 4.—The ſum of any rank, or ſeries, of quantities in continued arithmetical proportion, 1, 3, 5, 7, 9, 11, is equal to the ſum of the two extremes multiplied into half the number of terms.*

ARITHMETICAL

* The ſame thing alſo holds, when the number of terms is odd, as in the ſeries, 4, 8, 12, 16, 20; for then, the mean, or middle term, being equal to half the ſum of any two terms equally diſtant from it on contrary ſides, it is obvious that the value of the whole ſeries is the ſame as if every term thereof were equal to the mean, and therefore is equal to the mean (or half the ſum of the two extremes) multiplied by the whole number of terms; or to the ſum of the extremes multiplied by half the number of terms.

The ſum of any number of terms of the arithmetical ſeries of odd numbers, 1, 3, 5, 7, 9, &c. is equal to the ſquare of that number.

For

ARITHMETICAL PROGRESSION.

Any rank of numbers, more than two, increaſing by a common exceſs, or decreaſing by a common difference, is ſaid to be in Arithmetical Progreſſion.

If the ſucceeding terms of a progreſſion exceed each other, it is called an aſcending ſeries or progreſſion; if the contrary, a deſcending ſeries.

So { 0. 1. 2. 4. 6. 8, &c. is an aſcending arithmetical ſeries.
{ 1. 2. 4. 8 16. 32, &c. is an aſcending geometrical ſeries.
& { 8. 6. 4. 2. 1. 0, &c. is a deſcending arithmetical ſeries.
{ 32. 16 8. 4. 2. 1, &c. is a deſcending geometrical ſeries.

The numbers which form the ſeries, are called the terms of the progreſſion.

Note. The firſt and laſt terms of a progreſſion are called the extremes, and the other terms the means.

Any three of the five following things being given, the other two may be eaſily be found.

1. The firſt term.
2. The laſt term.
3. The number of terms.
4. The common difference.
5. The ſum of all the terms.

PROBLEM 1. *The firſt term, the laſt term, and the number of terms being given, to find the common difference.*

RULE.

For, 0+1 or the ſum of 1 term =12 or 1
1+3 or the ſum of 2 terms=22 or 4
4+5 or the ſum of 3 terms=32 or 9
9+7 or the ſum of 4 terms=42 or 16
16+9 or the ſum of 5 terms=52 or 25, &c.

Whence, it is plain, that let there be any number whatever, the ſum of its terms will be equal to its ſquare.

EXAMPLE.

The firſt term, the ratio, and number of terms given, to find the ſum of the ſeries

A Gentleman travelled 29 days; the firſt day he went but 1 mile, and increaſed every day's travel 2 miles: How far did he travel? $29 \times 29 = 841$ *miles the Anſwer.*

RULE.—Divide the difference of the extremes by the number of terms leſs 1, and the quotient will be the common difference ſought.

EXAMPLES.

1. The extremes are 3 and 39, and the number of terms is 19; What is the common difference?

$$\left.\begin{matrix}39\\-\ 3\end{matrix}\right\}\text{Extremes.}$$

Divide by the number of terms leſs 1 = 19 − 1 = 18) 36 (2 *Anſ.*
36

$$\text{Or, } \frac{39-3}{19-1} = 2.$$

2. A man had 10 ſons whoſe ſeveral ages differed alike; the youngeſt was 3 years old, and the eldeſt 48; What was the common difference of their ages?

$$\textit{Anſ.}\ \frac{38-3}{9-1} = 5.$$

3. A man is to travel from Boſton to a certain place in 9 days, and to go but 5 miles the firſt day, increaſing each day by an equal exceſs, ſo that the laſt day's journey may be 37 miles; required the daily increaſe?

$$\frac{37-5}{9-1} = 4 \textit{ the Anſwer.}$$

PROBLEM 2. *The firſt term, the laſt term, and the number of terms given, to find the ſum of all the terms.*

RULE.—Multiply the ſum of the extremes by the number of terms, and half the product will be the anſwer.

EXAMPLES.

EXAMPLES.

1. The extremes of an arithmetical ſeries are 3 and 39, and the number of terms 19; required the ſum of the ſeries?

$$\left.\begin{array}{r} 39 \\ +\ 3 \end{array}\right\} \text{Extremes.}$$

Sum = 42
Number of terms = × 19

378
42

2)798

399 *the Anſwer.*

Or, $\frac{39+3 \times 19}{2} = 399$

2. It is required to find how many ſtrokes the hammer of a clock would ſtrike in a week, or 168 hours, provided it increaſed 1 at each hour?

$$\frac{168+1 \times 168}{2} = 14196 \text{ } \textit{Anſ.}$$

3. Suppoſe a number of ſtones were laid a yard diſtant from each other for the ſpace of a mile, and the firſt, a yard from a baſket; what length of ground will that man travel over who gathers them up ſingly, returning with them one by one to the baſket?

$$\frac{3520+2 \times 1760}{2} = 3099360 \textit{ yds.} = 1761 \textit{ miles, Anſ.}$$

N. B. In this queſtion, there being 1760 yards in a mile, and the man returning with each ſtone to the baſket, his

his travel will be doubled; therefore the firſt term will be 2, and the laſt 1760 × 2, and the number of terms 1760.

4. A man bought 25 yards of linen in Arithmetical Progreſſion; for the 4th yard he gave 12 ſhillings, and for the laſt yard £3 15s.—What did the whole amount to, and, what did it average per yard?

$\frac{75-12}{22-1} = 3$ the common difference, by which the firſt term is found to be 3.

Then, $\frac{75+3\times 25}{2} = £48\ 15s.$ and the average price is £1. 19s. per yard.

5. Required the ſum of the firſt 1000 numbers in their natural order?

$$\frac{1000+1 \times 1000}{2} = 500500 \textit{ Anſwer.}$$

PROBLEM 3. *Given the extremes and the common difference, to find the number of terms.*

RULE.—Divide the difference of the extremes by the common difference, and the quotient increaſed by 1 will be the number of terms required.

EXAMPLES.

1. The extremes are 3 and 39, and the common difference 2; what is the number of terms?

$$\left.\begin{matrix}39\\-\ 3\end{matrix}\right\} \text{Extremes.}$$

Common difference = 2)36

Quotient = 18

Add 1

19 *the Anſwer.*

Or, $\frac{39-3}{2} + 1 = 19.$

2. A man, going a journey, travelled the firſt day 7 miles, the laſt day 51 miles, and each day increaſed his journey by 4 miles; How many days did he travel, and how far?

$\frac{51-7}{4}+1=12$ days, and $\frac{51+7\times 12}{2}=348$ *miles, Anſ.*

PROBLEM 4. *The extremes and common difference given, to find the ſum of all the ſeries.*

RULE.—Multiply the ſum of the extremes by their difference increaſed by the common difference, and the product divided by twice the common difference, will give the ſum.

EXAMPLES.

1. If the extremes are 3 and 39, and the common difference 2; what is the ſum of the ſeries?

39+3=42=Sum of the extremes.
39−3=36=Difference of extremes.
36+2=38=Difference of extremes increaſed by the common difference.

42
×38
336
126
Twice the common diff. =4)1596
399 *the Anſwer.*

Or, $\frac{39+3\times 39-3+2}{2\times 2}=339$

2. A owes B a certain ſum, to be diſcharged in a year, by paying 6d. the firſt week, 18d. the ſecond, and thus to increaſe every weekly payment by a ſhilling,

ſhilling, till the laſt payment be £2 11s. 6d. what is the debt?

$$\frac{51{,}5+{,}5 \times 51{,}5-{,}5+1}{1\times 2} = £67\ 12s.\ \textit{Anſ.}$$

PROBLEM 5. *The extremes and the ſum of the ſeries given, to find the common difference.*

RULE.—Divide the product of the ſum and difference of the extremes, by the difference of twice the ſum of the ſeries, and the ſum of the extremes, and the quotient will be the common difference.

EXAMPLE.

Let the extremes be 3 and 39, and the ſum 399: what is the common difference?

Sum of the extremes $=39+3=42$
Diff. of the extremes $=39-3=\times 36$

252
126

$399\times 2-42=756)1512(2$ *the Anſ.*
1512

Or, $\frac{3+39 \times 39-}{399\times 2-39+3} = 2.$

PROBLEM 6. *The extremes and the ſum of the ſeries given to find the number of terms.*

RULE.—Twice the ſum of the ſeries, divided by the ſum of the extremes, will give the number of terms.

EXAMPLE.

EXAMPLE.

Let the extremes be 3 and 39, and the ſum of the ſeries 399; what is the number of terms?

Sum of the ſeries = 399
× 2

Sum of the extr. = 39 + 3 = 42) 798 (19 *the Anſ.*
42

378
378

Or $\frac{399 \times 2}{39+3} = 19.$

GEOMETRICAL PROPORTION.

THEOREM 1.—If four quantities, 2, 6, 4, 12, be in geometrical proportion, the product of the two means, 6 × 4, will be equal to that of the two extremes, 2 × 12, whether they are continued, or diſcontinued; and, if three quantities, 2, 4, 8, the ſquare of the mean is equal to the product of the two extremes.

THEOREM 2.—If four quantities, 2, 6, 4, 12, are ſuch that the product of two of them, 2 × 12, is equal to the product of the other two, 6 × 4, then are thoſe quantities proportional.

THEOREM 3.—If four quantities, 2, 6, 4, 12, are proportional, the rectangle of the means, divided by either extreme, will give the other extreme.

THEOREM 4.—The products of the correſponding terms of two geometrical proportions are alſo proportional.

That is, if 2 : 6 :: 4 : 12 and 2 : 4 :: 5 : 10; then will 2 × 2 : 6 × 4 :: 4 × 5 : 12 × 10.*

THEOREM

* And if any quantities be proportional, their *ſquares, cubes*, &c. will likewiſe be proportional.

THEOREM 5.—If four quantities, 2, 6, 4, 12, are directly proportional,

Then,

1.	Directly,	$2 : 6 :: 4 : 12$
2.	Inverſely,	$6 : 2 :: 12 : 4$
3.	Alternately,	$2 : 4 :: 6 : 12$
4.	Compoundly	$2 : 8 :: 4 : 16$
5.	Dividedly,	$2 : 4 :: 4 : 8$
6.	Mixtly,	$8 : 4 :: 16 : 8$
7.	By Multiplication,	$2r : 6r :: 4 : 12$
8.	By Diviſion,	$\frac{2}{r} : \frac{6}{r} :: 4 : 12$

Becauſe the product of the means in each caſe, is equal to that of the extremes, and therefore the quantities are proportional by Theorem 2.

THEOREM 6.—If three numbers, 2, 4, 8, be in continued proportion, the ſquare of the firſt will be to *that* of the ſecond, as the firſt number to the third; that is, $2 \times 2 : 4 \times 4 :: 2 : 8$.

THEOREM 7.—In any continued geometrical proportion, (1, 3, 9, 27, 81, &c.) the product of the two extremes, and *that* of every other two terms, equally diſtant from them, are equal.

THEOREM 8.—The ſum of any number of quantities, in continued geometrical proportion, is equal to the difference of the rectangle of the ſecond and laſt terms, and the ſquare of the firſt divided by the difference of the firſt and ſecond terms.

GEOMETRICAL PROGRESSION.

A Geometrical Progreſſion is when a *Rank* or *Series*, of numbers, increaſes, or decreaſes, by the continual multiplication, or diviſion, of ſome equal number.

PROBLEM 1. *Given one of the extremes, the ratio, and the number of the terms of a Geometrical Series, to find the other extreme.*

RULE.—Multiply, or divide (as the caſe may require) the given extreme by ſuch power of the ratio, whoſe ex-

ponent

ponent* is equal to the *number* of terms leſs 1, and the product, or quotient, will be the other extreme.

EXAMPLES.

1. If the firſt term be 4, the ratio 4, and the number of terms 9; what is the laſt term?

1. 2. 3. 4. + 4= 8
4. 16. 64. 256. × 256=65536=Power of the ratio, whoſe exponent is leſs by 1, than the number of terms.

65536=8th power of the ratio.
Multiply by 4=firſt term.

262144=laſt term.
Or, $4 \times 4^8 = 262144$ = *the Anſ.*

2. If

*As the laſt term, or any term near the laſt, is very tedious to be found by continual multiplication, it will often be neceſſary, in order to aſcertain them, to have a ſeries of numbers in Arithmetical Proportion, called *Indices*, or *Exponents*, beginning either with a cypher or an unit, whoſe common difference is *one*.

When the *firſt* term of the ſeries and the *ratio*, are *equal*, the *indices* muſt begin with a unit, and, in this caſe, the product of any two terms is equal to that term ſignified by the *ſum* of their *indices*.

Thus, { 1. 2. 3. 4. 5. 6. &c Indices or Arithmetical ſeries.
2. 4. 8. 16. 32. 64. &c. Geometrical ſeries (leading terms.)

Now, 6+6=12=the index of the twelfth term, and
64 × 64=4096=the twelfth term.

But when the *firſt* term of the ſeries and the *ratio* are different, the *indices* muſt begin with a cypher, and the ſum of the *indices*, made choice of, muſt be *one leſs* than the *number of terms*, given in the queſtion; becauſe 1 in the *indices* ſtands over the *ſecond term*, and 2 in the *indices* over the third term, &c. And, in this caſe, the *product* of any *two* terms, divided by the *firſt*, is equal to that term *beyond* the firſt, ſignified by the *ſum* of their *indices*.

Thus. { 0. 1. 2. 3. 4. 5. 6, &c. Indices.
1. 3. 9. 27. 81. 243. 729, &c. Geometrical ſeries.

Here, 6 + 5. = 11 the Index of the 12th term.

729 × 243=177147 the 12th term, becauſe the firſt term of the ſeries and the ratio are different, by which mean a cypher ſtands over the firſt term,

Thus, by the help of theſe *indices*, and a few of the firſt terms in any geometrical ſeries, any term, whoſe diſtance from the firſt term is aſſigned, though it were ever ſo remote, may be obtained without producing all the terms.

2. If the laſt term be 262144, the ratio, 4, and the number of terms 9; what is the firſt term?

8th power of the ratio $4^8=65536)262144=$ the firſt (term.

262144

Or, $\frac{262144}{4^8}=4$ the firſt term.

Again, Given the firſt term, and the ratio to find any other term aſſigned.

RULE 1.—When the indices begin with an unit.

1. Write down a few of the leading terms of the ſeries, and place their indices over them.

2. Add together ſuch indices, whoſe ſum ſhall make up the entire index to the term required.

3. Multiply the terms of the geometrical ſeries, belonging to thoſe indices, together, and the product will be the term ſought.

1. If the firſt term be 2, and the ratio 2; what is the 13th term?

1. 2. 3. 4. 5 + 5 + 3 = 13
2. 4. 8. 16. 32 × 32 × 8 = 8192 *Anſ.*
Or, $2\times2^{12}=8192$.

2. A merchant wanting to purchaſe a cargo of horſes for the Weſtindies, a jockey told him he would take all the trouble and expenſe, upon himſelf, of collecting and purchaſing 30 horſes for the voyage, if he would give him what the laſt horſe would come to by doubling the whole number by a half penny, that is, two farthings for the firſt, four for the ſecond, eight for the third, &c. to which the merchant, thinking he had made a very good bargain, readily agreed: Pray, what did the laſt horſe come

Note. If the *ratio* of any geometrical ſeries be *double*, the *difference* of the *greateſt* and *leaſt* terms is equal to the ſum of all the terms, except the greateſt: If the *ratio* be *triple*, the *difference* is *double* the ſum of all but the greateſt: If the *ratio* be *quadruple*, the difference is *triple* the ſum of all but the greateſt, &c

In any geometrical ſeries decreaſing, and continued *ad infinitum*, *half* the *greateſt* term is equal to the *ſum* of all the remaining terms, *ad infinitum*.

come to ; and, what did the horſes, one with another, coſt the merchant?

[30*th*, or laſt term.

1. 2. 3. 4. 5. 6+ 6= 12*th*. 12 + 12 + 6= 2. 4. 8. 16. 32. 64 × 64=4096&4096 × 4096 × 14= 1073741824 *grs.*=£1118481 1*s.* 4*d.* and their average price was £37232 14*s.* 0½*d.* a piece.

RULE 2.—When the indices begin with a cypher.

1. Write down a few of the leading terms of the ſeries, as before, and place their indices over them.

2. Add together the moſt convenient indices to make an Index, leſs by 1 than the number expreſſing the place of the term ſought.

3. Multiply the terms of the geometrical ſeries, together, belonging to thoſe indices, and make the product a dividend.

4. Raiſe the firſt term to a power, whoſe index is one leſs than the number of terms multiplied, and make the reſult a diviſor, by which divide the dividend, and the quotient will be that term beyond the firſt, ſignified by the ſum of thoſe indices, or the term ſought.

5. If the firſt term be 5, and the ratio 3, What is the 7th term.

0. 1. 2. 3+ 2+ 1= 6=Ind. to the term beyond 1*ſt*, or 7*th*.

5. 15. 45. 135 × 45 × 15=91125=Dividend.

The number of terms, multiplied, is 3 (viz. 135 × 45 × 15) and 3—1=2, is the power to which the term 5 is to be raiſed; but the 2d power of 5 is 5 × 5=25, and therefore 91125÷25=3645 the 7th term required.

PROB. 2. *Given the firſt term, the ratio, and number of terms, to find the ſum of the ſeries.*

RULE.—Raiſe the ratio to a power, whoſe Index ſhall be equal to the number of terms, from which ſubtract 1; divide the remainder by the ratio, leſs

1, and

1, and the quotient multiplied by the firſt term, will give the ſum of the ſeries.

Examples.

1. If the firſt term be 5, the ratio 3, and the number of terms 7; What is the ſum of the ſeries?

Ratio = 3 × 3 × 3 × 3 × 3 × 3 × 3 = 2187 = 7th power
Subtract 1 (of the ratio.

Divide by the ratio leſs 1 = 3 − 1 = 2) 2186

Quotient = 1093
Multiply by the 1ſt term = 5

Sum of the ſeries = 5465

Or, $\frac{3^7 - 1}{3 - 1} \times 5 = 5465$ *Anſ.*

2. A ſhopkeeper ſold 13 yards of cloth on the following terms, viz 2d. for the firſt yard, 4d for the ſecond, 8d. for the third, &c. I demand the price of the cloth.

$\frac{2^{13} - 1}{2 - 1} \times 2 = 16382\text{d.} = 68\text{l. } 5\text{s. } 2\text{d.}$ *Anſ.*

3. A gentleman, whoſe daughter was married on a new year's day, gave her a guinea, promiſing to triple it on the firſt day of each month in the year? Pray what did her portion amount to?

$\frac{3^{12} - 1}{3 - 1} \times 1 = 265120$ guineas, *Anſ.*

4. What debt can be diſcharged in a year, by paying 1 ſhilling the firſt month, 10s. the ſecond, and ſo on, each month in a tenfold proportion?

$10^{12} - 1 \div 10 - 1 \times 1 = 11111111111$ ſhillings, = 555555555l. 11s. *Anſ.*

5. A man threshed wheat 9 days for a farmer, and agreed to receive but 8 wheat corns for the first day's work, 64 for the second, and so on in an eight fold proportion; I demand what his 9 day's labour amounted to, rating the wheat at 5s. per bushel ?*

$\frac{8^{9}-1}{8-1} \times 8 = 153391688$ corns. Amount = 78l. (0s. $5\frac{1}{2}$d.

6. An ignorant fop wanting to purchase an elegant house; a facetious gentleman told him he had one which he would sell him on these moderate terms, viz. that he should give him a penny for the first door, 2d. for the second, 4d. for the third, and so on, doubling at every door, which were 36 in all; it is a bargain, cried the simpleton, and here is a guinea to bind it; Pray what would the house have cost him ?

Ans. $\frac{2^{36}-1}{2-1} \times 1 = 68719476735$d. $= 286331153$l. 1s. (3d.

7. A young fellow, well skilled in numbers, agreed with a rich farmer to serve him 10 years, without any other reward, but the produce of one wheat corn for the first year, and that produce to be sowed from year to year, till the end of the time, allowing the increase but in a tenfold proportion? What is the sum of the whole produce! and, what will it amount to, at 5s per bushel ?

Ans. $\frac{10^{10}-1}{10-1} \times 10 = 11111111110$ corns. Amount (= 5653l. 8s. $0\frac{9}{10}$d.

8. Suppose one farthing had been put out at 6l per cent. per annum, compound interest,† at the commencement

* Note, 7680 wheat or barley corns are supposed to make a pint.

† any sum, at 6l. per cent per annum, compound interest will double in 11 years and three hundred and twenty five days, or 11 889 years, or 11.89 is near enough; then if you divide 1784 by 11,89, it will give the number of terms in this case equal to 150;—The ratio will be 2, and the first term 1.

ment of the Chriſtian Æra: what would it have amounted to in 1784 years; and ſuppoſe the amount to be in ſtandard gold, allowing a cubick inch to be worth 53l. 2s. 8d. how large would the maſs have been?

$$Anſ. \frac{2^{150}-1}{2-1}+1=1486716346568748209435714551509890767065361l.\ 11s.\ 3\tfrac{3}{4}d.$$

$$=279808597221212304159797123293359421076$$

(cubick inches of gold.

As, 355 : 113 :: 360×69,5 : 7964 Earth's diameter.

360×69,5×7964×1327,33 = 26448282012 2 cubick miles in the globe = 67273337308854741368832000 inches in the globe. Then, 279808597221212304159 795712329335942107664 67273337308854741368 832000=41593089984028 8,8 which however incredible it may appear to ſome, is more than four hundred and fifteen millions of millions, nine hundred and thirty thouſand, eight hundred and ninety nine millions, eight hundred and forty thouſand, two hundred and eighty eight times larger than the globe we inhabit.

PROBLEM 3. *The firſt term, the laſt term, (or the extremes) and the ratio given, to find the ſum of the ſeries.*

RULE.—Divide the difference of the extremes by the ratio leſs by 1: Add the greater extreme to the quotient, and the reſult will be the ſum of all the terms.

Or, multiply the greateſt term by the ratio, from the product ſubtract the leaſt term; then divide the remainder by the ratio, leſs by 1, and the quotient will be the ſum of all the terms.

Or, when all the terms are given, then, from the product of the ſecond and laſt terms ſubtract the ſquare of the firſt term; this remainder being divided by the ſecond term leſs the firſt, will give the ſum of the ſeries.

EXAMPLES.

1. If the ſeries be 2. 6. 18. 54. 162. 486. 1458. 4374; What is its ſum total?

Firſt

First Method.

From the greateſt term = 4374
Subtract the leaſt = 2

Divide by the ratio, leſs 1=3—1=2)4372 diff. of ex.

Quotient = 2186
Add the greater extreme = 4374

6560

Or, $\frac{4374-2}{3-1}+4374=6560$ *Anſ.*

Second Method.

Greateſt term = 4374
Multiply by the ratio = 3

Product = 13122
Subtract the leaſt term = 2

Divide by the ratio, leſs by 1×3—1=2)13120

Anſ. 6560

Or, $\frac{4374\times 3-2}{3-1}=6560$

Third Method.

Greateſt term = 4374
Multiply by the ſecond term = 6

Product = 26244
Subtract the ſquare of the firſt term=2X2= 4

Div. the rem. by the 2d term leſs the 1ſt=6–2=4)26240

Anſ. 6560

Or, $\frac{4374\times 6-4}{6-2}=6560$

2.

2. A man travelled 6 days; the firſt day he went 4 miles, and each day doubling his day's travel, his laſt day's ride was 128 miles; How far did he go in the whole?

$$\frac{128-4}{2-1}+128=252 \text{ miles, } \textit{Anſ.}$$

3. A gentleman dying, left 5 ſons; to whom he bequeathed his eſtate as follows, viz. to his youngeſt ſon 1000l.; to the eldeſt 5062l. 10s. and ordered that each ſon ſhould exceed the next younger by the equal ratio of $1\frac{1}{2}$; What did the ſeveral legacies amount to?

$$\frac{5062,5-1000}{1,5-1}+5062,5=13187\text{l. }10\text{s. } \textit{Anſ.}$$

PROB. 4. *Given the extremes and ratio, to find the number of terms.*

RULE.—Divide the greateſt term by the leaſt; find what power of the ratio is equal to the quotient; then, add 1 to the index of that power, and the ſum will be the number of terms.

Or, Subtract the logarithm* of the leaſt term from that of the greateſt; divide the remainder by the logarithm of the ratio, and add 1 to the quotient.

EXAMPLE.

If the leaſt term be 2, the greateſt term 4374, and the ratio 3, What is the number of terms?

Divide by the leaſt term $=2)4374=$ greateſt term,

$3\times3\times3\times3\times3\times3\times3=$ Quo. $2187=7$th power, then $7+1=8$ the *Anſ.*

Or,

*Logarithms are artificial numbers, the addition of which anſwers to multiplication of whole numbers, and ſubtraction to diviſion.

Or,

From the logarithm of the greateſt term = 3.64088
Subtract the logarithm of the leaſt term = 0.30103

Divide the remainder by the logarithm of the ratio = ,47712)3.33985(7+1=8 *Anſ.*
3.33984
1

PROB. 5. *Given the leaſt term, the ratio, and the ſum of the ſeries, to find the laſt term.*

RULE.—Multiply the ſum of the ſeries by the ratio, leſs 1; to that product add the firſt term, and the reſult divided by the ratio, will give the laſt term.

EXAMPLE.

If the 1ſt term be 2, the ratio 3, and the ſum of the ſeries 6560; What is the laſt term?

$$\frac{3-1\times 6560+2}{3}=4374 \text{ } Anſ.$$

SIMPLE INTEREST.

Intereſt is a premium allowed by the borrower of any ſum of money to the lender, according to a certain rate per cent. agreed on, which by law is ſtated at 6l. that is, 6 for the uſe of 100l. for one year.

Principal is the money lent.

Rate is the ſum per cent. agreed on.

Amount is the principal and intereſt added together.

Intereſt is of two ſorts, *ſimple* and *compound*.

Simple intereſt is that, which is allowed for the principal lent only.

Note. The rules for ſimple intereſt ſerve alſo to calculate commiſſion, brokerage, inſurance, purchaſing ſtocks, or any thing elſe rated at ſo much per cent.

GENERAL

General Rule.

1. Multiply the principal by the rate, and divide the product by 100 (or, which is the same, cut off the two right hand figures in the pounds, which must be reduced to the lowest denomination, each time cutting off as at first) and the quotient will be the answer for one year.

2. For more years than one, multiply the interest of one year by the given number of years, and the product will be the answer for that time.

3. If there be parts of a year, as months, or days, work for the months by the aliquot parts of a year, and for the days by the Rule of Three Direct, or (which is sufficiently exact for common use, allowing 30 days to the month) take aliquot parts of the same.

Note, when the rate per cent. per annum, is	£.		multiply the principal by		of the given number of months, cutting off as before directed, and you will have the interest for the given time.
	9			¾	
	8			½	
	6			⅓	
	4			¼	
	3			⅙	
	2			1	

Examples.

1. What is the interest of 573l. 13s. 9½d. for one year, at 6 per cent. per annum?

£.	s.	d.
573	13	9½
		6
34|42	2	9
20		
8|42		
12		
5|13		
4		
c|52		

Anſ. 34l. 8s. 5d.

2. What

2. What is the intereſt of 329l. 17 $6\frac{1}{2}$ for 3 years, 7 months and 12 days, at 5l per cent. per annum?

£.	s.	d.
329	17	$6\frac{1}{2}$
		5
16|49	7	$8\frac{1}{5}$
20		
9|87		
12		
10|52		
4		
2|10		

Then,

6 months	$\frac{1}{2}$	16 9 $10\frac{1}{2}$	intereſt of 1 year
		3	
		49 9 $7\frac{1}{2}$	ditto of 3 years
1 month	$\frac{1}{6}$	8 4 $11\frac{1}{4}$	ditto of 6 months
10 days	$\frac{1}{3}$	1 7 $5\frac{3}{4}$	ditto of 1 month
2 days	$\frac{1}{5}$	9 $1\frac{3}{4}$	ditto of 10 days
		1 $9\frac{1}{4}$	ditto of 2 days

	Y.	m.	d.
£59 13	ditto of 3	7	12

Or thus:

		£.	s.	d.
£5	$\frac{1}{20}$	329	17	$6\frac{1}{2}$
6 months	$\frac{1}{2}$	16	9	$10\frac{1}{2}$
				3
				7
		49	9	$1\frac{1}{2}$
1 Ditto	$\frac{1}{6}$	8	4	$1\frac{1}{4}$
10 days	$\frac{1}{3}$	1	7	$1\frac{3}{4}$
2 days,	$\frac{1}{5}$		9	$1\frac{3}{4}$
			1	$9\frac{1}{4}$
		£59	13	*Anſ.*

3. What

3. What is the intereſt of 439l. 12s. $9\frac{1}{2}$d. at 6l. per cent. per annum, for 16 months?

£.	s.	d.
439	12	$9\frac{1}{2}$

$8=\frac{1}{2}$ the number of months.

Anſ. £35|17 2 4

20

s. 3|42

12

d. 5|08

4. What is the intereſt of 591l. 15s. $9\frac{1}{4}$d. for 15 months, at 8l. per cent. per annum?

£591 15 $9\frac{1}{4}$

$10=\frac{2}{3}$ the number of months.

£59|17 17 $8\frac{1}{2}$

20

s. 3|57

12

d. 6|92

4

qrs. 3|70

5. What is the intereſt of 347l. 7s. $5\frac{1}{2}$d. at 4l. per cent. per annum, for 15 months?

£347 7 $5\frac{1}{2}$

$5=\frac{1}{3}$ the number of months.

£17|36 17 $3\frac{1}{2}$

20

s. 7|37

12

d. 4|47

4

qr. 1|90

6. What

6. What is the interest of £517 15 4 for one month, at 6l. per cent. per annum ?
Anſ. £2 11 9¼

7. Of £457 12 8½ for 2 months, at 6l. per cent. per annum ? *Anſ.* £4 11 6¼

8. Of £347 5 9 for 3 months, at 6l. per cent. per annum ? *Anſ.* £5 4 2

9. Of £397 19 for 4 months, at 6l. per cent. per annum ? *Anſ.* £7 19 2

10. £508 10 5½ for 5 months, at 6l. per cent. per annum ? *Anſ.* £12 14 3¼

11. £719 19 4 for 6 months, at 6l. per cent. per annum ? *Anſ.* 21 11 1¾

12. £396 5 10 for 7 months, at 6l. per cent. per annum ? *Anſ.* £13 17 4¾

13. £517 18 11½ for 8 months, at 6l. per cent. per annum ? *Anſ.* £20 14 0¾

14. £245 5 8¾ for 9 months, at 6l. per cent. per annum ? *Anſ.* £11 0 9

15. £195 15 5½ for 10 months, at 6l. per cent. per annum ? *Anſ* £9 15 9¼

16 £148 12 6½ for 11 months, at 6l. per cent. per annum ? *Anſ.* £8 3 5½

17. £509 9 2 for 13 months, at 6l. per cent. per annum ? *Anſ.* £33 2 3½

18. £317 17 8½ for 14 months, at 6l. per cent. per annum ? *Anſ.* £22 5 0¼

19. £443 10 3 for 15 months, at 6l. per cent. per annum ? *Anſ.* £33 5 3

20. £293 7 9 for 16 months, at 6l. per cent. per annum ? *Anſ.* £23 9 5

21. £333 13 3¾ for 17 months, at 6l. per cent. per annum ? *Anſ.* £28 7 2¼

22. £517 6 6 for 18 months, at 6l. per cent. per annum ? *Anſ.* £46 11 2

23. £347 11 7½ for 19 months, at 6l. per cent. per annum ? *Anſ.* £33 0 4¼

24. £419 12 5 for 20 months, at 6l. per cent. per annum ? *Anſ.* £41 19 2¾

25.

25. £537 13 $5\frac{1}{2}$ for 16 months, at 9l. per cent. per annum? Anſ. £64 10 $4\frac{3}{4}$

26. £1 for 1 year at 6 per cent. per annum?
Anſ. 1s. 2d. $1\frac{6}{10}$qr.

SIMPLE INTEREST BY DECIMALS.

A TABLE of RATIOS, from one pound &c. to ſeven pounds.

Rate per Cent	Ratios	Rate per Cent	Ratios	Rate per Cent	Ratios
1	,01	3	,03	5	,05
$1\frac{1}{4}$	,0125	$3\frac{1}{4}$	,0325	$5\frac{1}{4}$	,0525
$1\frac{1}{2}$	,015	$3\frac{1}{2}$	,035	$5\frac{1}{2}$	,055
$1\frac{3}{4}$	,0175	$3\frac{3}{4}$	,0375	$5\frac{3}{4}$	,0575
2	,02	4	,04	6	,06
$2\frac{1}{4}$	,0225	$4\frac{1}{4}$	,0425	$6\frac{1}{4}$	,0625
$2\frac{1}{2}$	,025	$4\frac{1}{2}$	,045	$6\frac{1}{2}$	,065
$2\frac{3}{4}$	,0275	$4\frac{3}{4}$	,0475	$6\frac{3}{4}$	,0675

Ratio is the ſimple intereſt of 1l. for 1 year at the rate per cent agreed on.

A TABLE *for the ready finding of the decimal parts of a year, equal to any number of* days, *or* quarters *of a* year.

Days	Decimal pts.	D.	Decimal pts.	Days	Decimal pts.
1	,00274	10	,027397	100	,273973
2	,005479	20	,054794	200	,547945
3	,008219	30	,082192	300	,821918
4	,010959	40	,109589	365	1,000000
5	,013699	50	,136986	$\frac{1}{4}$ of a year	=,25
6	,016438	60	,164383	$\frac{1}{2}$ of a year	=,5
7	,019178	70	,191781	$\frac{3}{4}$ of a year	=,75
8	,021918	80	,219178		
9	,024657	90	,246575		

CASE 1.

The principal time and ratio are given to find the intereſt, and amount.

RULE.—Multiply the principal, time and ratio continually together, and the laſt product will be the intereſt, commiſſion,

commiſſion, brokerage, &c. to which add the principal, and the ſum will be the amount.

EXAMPLES.

1. Required the amount of £537 10s. at 6l. per cent. per annum, for 5 years ?

Principal 537,5
Multiply by the ratio=,06

Product 32,250
Multiply by the time = 5

Intereſt = 161,250
Add the principal = 537,5

Amount = £698,75
20

15,00 *Anſ.* £698 15s.

Or, 537,5 × ,06 × 5 + 537,5 = 698l. 15s,

2. What is the ſimple intereſt of 917l. 16s. at 5½ per cent. per annum, for 7 years ?

Anſ. 321l. 4s. 7d.

3. What is the amount of 235l. 3s 9d. at £5¼ per cent. per annum, from March 5th, 1794, to November 23d, 1794 ?

Anſ. 244l. 0s. 8½d.

4. If my correſpondent is to have 2½l. per cent. What will his commiſſion on 785l. 15s amount to ?

Anſ 19l 12s 10½

5. If a broker diſpoſes of a cargo for me, to the amount of 637l. 10s. on commiſſion at 1¼l. per cent. and procures me another cargo of the value of 817l. 15s on commiſſion at 1½l. per cent. What will his commiſſion on both cargoes, amount to ?

Anſ. 22l. 5s. 7d.

CASE

CASE II.

The amount time and ratio given, to find the principal.

RULE. Multiply the ratio by the time; add unity to the product for a divisor, by which sum divide the amount, and the quotient will be the principal.

EXAMPLES.

1. What principal will amount to 1045l. 14s. in 7 years at 6l. per cent. per annum?

Ratio =,06
Multiply by the time= 7

Product =,42
Add 1

Divisor=1,42)1045,7(736,40845 = 736l. (8s. 2d.

2. What principal will amount to 3810l. in 6 years at $4\frac{1}{2}$l. per cent. per annum? *Anſ.* 3000l.

3. What principal will amount to 666l. 9s. $0\frac{1}{4}$d. in $3\frac{1}{2}$ years, at $5\frac{1}{4}$l. per cent per annum?

Anſ. 563l.

CASE III.

The amount, principal and time given, to find the ratio.

RULE. Subtract the principal from the amount; divide the remainder by the product of the time and principal, and the quotient will be the ratio.

EXAMPLES.

1. At what rate per cent. will 543l. amount to 705l. 18s. in 5 years?

From the amount=705,9
Take the principal=543

Divide by 543X5=2715)162,90(,06=6l. *Anſ.*
162,90

2. At what rate per cent. will 391l. 17s. amount to 449l. 3s. 1¼,749r. in 3¼ years? *Anſ.* 4½l.

3. At what rate per cent. will 413l. 12s. 6d. amount to £546 3s. 8d. in 4¾ years? *Anſ.* 6½l.

CASE IV.

The amount principal and rate per cent. given, to find the time.

RULE. Subtract the principal from the amount; divide the remainder by the product of the ratio and principal; and the quotient will be the time.

EXAMPLES.

1. In what time will 543l. amount to 705l. 18s. at 6l. per cent. per annum?

From the amount = 705,9
Take the principal = 543

Divide by 543X,06=32,58)162,9(5 years, *Anſ.*
162,9

2. In what time will 3000l. amount to 3810l. at 4½ per cent. per annum? *Anſ.* 6 years.

To find the Intereſt of any ſum, at 6 per cent. per annum, for any number of months.

RULE. If the months be an even number, multiply the principal by half that number: and if the months be uneven, halve the even months; to which annex $\frac{5}{10}$; thus, the half of 9 is 4,5 and multiply the principal as before, cutting off two figures more at the right hand, than there are decimals in both factors, which reduce to farthings, each time cutting off as at firſt.

3. What

3. What is the intereſt of 345l. 16s. 6d. for 9 years and 11 months, at 6 per cent per annum?

Y M.
9 11
12

2)119

345,825 59,5 = $\frac{1}{2}$ No. of months.
59,5

1729125
3112425
1729125

£205,765875 = £205 15 3$\frac{1}{4}$ *Anſ.*
Principal = £345 16 6

Amount = 551 11 9$\frac{1}{4}$

A TABLE *of Decimal parts for every day in the twelfth part of a year, which conſiſts of* 365$\frac{1}{4}$ *days.*

days	dec. pts	days	dec. pts	days	dec. pts	days	dec. pts	days	dec. pts
1	,033	7	,23	13	427	19	,624	25	,821
2	,066	8	,263	14	,46	20	,657	26	854
3	,098	9	296	15	,493	21	,69	27	,887
4	,131	10	,328	16	,526	22	,723	28	,92
5	,164	11	,361	17	,558	23	,756	29	,953
6	,197	12	,394	18	591	24	,788	30	,986

Note. This table may alſo be uſed for the parts of a year, in compound intereſt, after having worked for whole years.

To find the intereſt of any ſum, either for months, or months and days, at 6 *per cent. per annum.*

RULE. Multiply the principal by the number of months (and parts, if any, anſwering to the given number of days in the table) and cut off one figure at the right hand of the product more than is required by the rule in decimals, and the product will be the intereſt for the

the given time in shillings and decimal parts of a shilling.

What is the interest of 25l. 10s. for 19 months and 7 days.

Principal=£250,5
Time=19,23

7515
5010
22545
2505

Ans. s. 481,7115
=£24 1s. 8½d.

Another Method of calculating Interest for Months at 6l. per cent. per annum.

Rule. If the principal consist of pounds only, cut off the unit figure, and, as it then stands, it will be the interest for one month in shillings and decimal parts: If it consist of pounds, shillings, &c. reduce the shillings, &c. to decimals, which, with the unit figure of the pounds, will be decimal parts of a shilling.

Examples.

1. What is the interest of 175l. for 5 months?

175l.=17,5 shillings=interest for 1 month.

17,5
Mult. by the time= 5

2|0|87,5

Ans.=4l. 7s. 6d.

2. What is the interest of 255l. 16s. for 7 months?

Shill.
£255 16=25,58 Int. for 1 mon.
7

2|0|179,06

8l. 19s. 0½d.

SIMPLE

SIMPLE INTEREST IN FEDERAL MONEY.

PROB. 1. *When the principal is given in Maſſachuſetts pounds, ſhillings, &c. and the intereſt is required in federal money, at 6 per cent. per annum.*

RULE. Reduce the ſhillings, &c. to their equivalent decimal, by inſpection, divide the whole by 5, and the quotient is the annual intereſt: Or, multiply the principal by 2, and the product (having the unit figure of the pounds cut off) will be the intereſt as before.

EXAMPLES.

1. Required the annual intereſt of 517l 3s. 7½d. at 6 per cent.?

3s. = .15
1½d. = .30
Excels of 12 = 1

,181

5)517,181 Dols. c. m.
103,436 = 103,43,6

Or, 517,181
2

Dols. c. m.
103,4362 = 103,43.6 $\frac{2}{10}$

2. Required the annual intereſt of 1l. in dollars?

5)1,00
20 cents *Anſ.*

PROB. 2. *When the principal is given in Maſſachuſetts pounds, ſhillings, &c and the intereſt and amount are required in federal money, at 6 per cent.*

RULE. Reduce the lawful money to federal, then divide the principal by 20, and that quotient by 5; add thoſe quotients together and they are the intereſt; or, add them to the principal, and their ſum is the amount.

EXAMPLES.

1. Required the amount of 425l. 16s. 8½d. for one year at 6 per cent.?

,8	3)425,835
34	
1	20)1419,450
	5)70,9725
,835	14,1945
	Dols. c. m.
	1504,6170=1504,61,7 *Anſ.*

2. Required the amount of 112l. 4s. 6d. for 1 year?

,2	3)112,225
24	
1	20)374,083
	5)18,7041
,225	3,7408
	Dols. c. m.
	396,52,79=396,32,57,9 *Anſ.*

BROK. 3. *When the principal is Maſſachuſetts pounds, ſhillings, &c. and the monthly intereſt is required in federal money.*

RULE. Reduce the ſhillings, &c. to decimals, by inſpection, then ſeparate the right hand figure of the pounds with he decimals, divide by 6, and the quotient is the anſwer in dollars, cents, &c.

EXAMPLE.

Required the monthly intereſt of 425l. 16s. 8½d. in federal money?

8	
34	6)42,5835 Dols. c m.
1	7,09725=7,09,7½ *Anſ.*
835	

Brok.

PROB. 4. *When the principal is federal money, and the interest is required in the same.*

RULE. Work according to the general rule in simple interest, that is multiply by the rate of interest, separate the two right hand figures of the dollars in the product, and it will give the interest in dollars, cents, &c.

N. B. The figures which are more than three places to the right hand of the comma, are of no account.

EXAMPLES.

1. What is the annual interest of 537D. 24c. 6m. at 6 per cent. ?

D. c. m.
537,24,6
6
———
D. c. m.
32,23476=32,23,4 *Ans.*

2. What is the interest of 1465D. 46c. 6m. for 16 months at 6 per cent per annum ?

D. c. m.
1465,46,6
8=half the number of months.
———
D. c. m.
117,23728=117,23,7 *Ans.*

3. What is the interest of 537D. 34c. 7m. for 19 months, at 6 per cent. per annum ?

537,34,7
9,5=half the number of months.
———
2686735
4836123
———
D. c. m.
51,047965=51,04,7 *Ans.*

N. B.

N. B. Becauſe there are 4 decimals in the multiplicand and multiplier, I cut off 4 figures for them, and two more according the rule.

PROB. 5. *When the principal is federal money, and the monthly intereſt is required in the ſame, at 6 per cent. per annum.*

RULE. Separate the two right hand figures of the dollars, and you then have the intereſt of 2 months; half of which is the monthly intereſt in dollars, cents, &c. If there is but one place, or figure, of dollars, a cypher muſt be prefixed to the left hand.

EXAMPLES.

1. What is the monthly intereſt of 9D. 59c. 7m. at 6 per cent. per annum?

2),09597 c. m.

,047985=4,8 nearly, Anſ.

2. What is the monthly intereſt of 100D. 50c. 5m.?

2)1,00505 c. m.

,50252=50,2½ *Anſ.*

Rules for calculating Intereſt for Days.

RULE 1. Multiply the given principal by the given number of days, and that product by the rate on the pound; divide the laſt product by 365, and it will give the intereſt.

EXAMPLE.

What is the intereſt of 360l. 10s. for 175 days, at 6 per cent.?

$$\frac{360,5 \times 175 \times ,06}{365} = £10,37 = 10l.\ 7s.\ 4\tfrac{1}{2}d.\ \textit{Anſ.}$$

RULE 2. Multiply the given principal by the given number of days, and divide the product by 6083, for 6l. per cent. the number of days, in which any ſum will

will double, at that rate, the quotient will give the anſwer.

EXAMPLE.

What is the intereſt of 327l. 10s. at 6 per cent. per annum, for 210 days?

$$\frac{327{,}5 \times 210}{6033} = £11{,}306 = 11l.\ 6s.\ Anſ.$$

Rule for making a Diviſor for any rate per cent.

Multiply 365 by 100, and divide the product by the rate.

Thus, for 6 per cent. $\frac{365 \times 100}{6} = 6083$ diviſor.

For 5 per cent. $\frac{365 \times 100}{5} = 7300$ diviſor, &c.

Hence, when intereſt is to be calculated on caſh accounts, accounts current, or any other accounts, where partial payments are made, or partial debts are contracted; multiply the ſeveral balances into the days they are at intereſt, and the ſum of theſe products, divided as above, will give the intereſt at 5l. or 6l. per cent and for any other rate, make the proper addition or deduction: or find a diviſor, as before directed.

EXAMPLE.

On the 1ſt of January I lent £450 10 6, which I received back in the following partial payments, viz. on the 15th of January, £57 11 9; on the 7th of February, £39 3 10; on the 19th of March, 63 5 2; on the 4th of April, £45; on the 26th of April, £19 12 6; on the 12th of May, £100; on the 10th of June, £60 7 3; and on the firſt of Auguſt, £65 10; what intereſt is due at 6 per cent.?

Dates.

Dates.			£.	s.	d.	Days.	Products. £.	s.	d.
Jan.	1	Lent on demand	450	10	6	14	6307	7	0
	15	Received in part	55	11	9				
		Balance	392	18	9	24	9430	10	
Feb.	7	Received in part	39	3	10				
		Balance	353	14	11	40	14149	16	8
Mar.	19	Received in part	63	8	2				
		Balance	290	9	9	16	4647	16	
April	4	Received in part	45	0	0				
		Balance	245	9	9	22	5400	14	6
Ditto	26	Received in part	19	12	6				
		Balance	225	17	3	16	3613	16	
May	12	Received in part	100	0	0				
		Balance	125	17	3	29	3650	0	3
June	10	Received in part	60	7	3				
		Balance	65	10	0	52	3406	0	0
Aug.	1	Receiv'd in full of the principal	65	10					
							50	606	0

£. s d.
6083)50606 0 0(8 6 4½ *Anſ.*

I have given Peter Truſty a caſh credit for 1000l. in conſequence of which, on the 12th of May, I paid his bill for 250l ; ditto 27th paid his draught for 280l. ; June 1ſt he gave me a bill on the Maſſachuſetts bank, at ſight, for 290l. ; July the 17th he paid me per receipt 70l. ; Auguſt 20th he drew for 750l. at ſight ; ditto 31ſt he paid me per receipt, 500l. ; September 13th he drew at ſight for 135l. ; and 3d of October for 175l. ; October 29th he paid me per receipt, 250l. ; and November 3d 125l. ; November 12th he drew at ſight for 375l. and ditto 18th for 125l. ; January 1ſt he paid me

me per receipt 290l and 20th ditto 210l. ; on the 1st of March following he demands a ſettlement ; what is then due to me, intereſt at 6 per cent.

Dates			£.	Days.	Products.
May	12	Paid his bill	250	15	3750
Ditto	27	Paid his draught	280		
		Balance	530	5	2650
June	1	Received in part	290		
		Balance	240	46	11040
July	17	Received in part	70		
		Balance	170	34	5780
Auguſt	20	Paid	750		
		Balance	920	11	10120
Ditto	31	Received in part	500		
		Balance	420	15	6300
Sept.	15	Paid	135		
		Balance	555	18	9990
October	3	Paid	175		
		Balance	730	62	18985
Ditto	29	Received in part	250		
		Balance	485	5	2400
Nov.	3	Received in part	120		
		Balance	355	9	3195
Ditto	12	Paid	375		
		Balance	730	6	4380
Ditto	18	Paid	125		
		Balance	855	62	53010
January	1	Received in part	290		
		Balance	565	19	10735
Ditto	2	Received in part	210		
March	1	Balance	355	40	14200

Yrossos Thom.

Then,

73|00)1565|30

5)21 8 10 Int. at 5l. per cent per annum.
4 5 10 add.

25 14 8 Int. at 6 per cent. on said account.
355 Balance of the account.

£380 14 8 Total balance in my favour.

When cash credits are given, a balance should be made upon every transaction, which should be multiplied into the days, the first leisure minute: then when the time of settlement comes, you will only have to add up the products, and divide as above, and the account will be finished.

A owes B the following sums, with the interest on them at 6 per cent. per annum, as follows, viz 60l. for 7 months; 150l. for 5 months; 75l 10s. for 9 months; 145l 15s. for 7 months, and 397l. 12s. for 4½ months; what is the amount of principal and interest;

£.		Months.		
60	X	7	=	420
150	X	5	=	750
75,5	X	9	=	679,5
145,75	X	7	=	1020,25
397,6	X	4,5	=	1789,2

200)4648,95
23,24
828,85

Amount, *Ans.* £852,09

Note.

Note. I divide by 200, the number of months, in which any ſum will double at 6 per cent. per annum, and it gives the intereſt.

When partial payments are made upon notes, bonds, &c. at any interval greaterthan ayear, the intereſt is calculated in a progreſſive manner, by adding the intereſt to the principal of the time of the firſt payment and from the ſum deducting the payment, &c.

DISCOUNT

Is an allowance made for the payment of any ſum of money, before it becomes due, and is the difference between that ſum due ſome time hence, and its preſent worth.

The preſent worth of any ſum, or debt, due ſome time hence, is ſuch a ſum, as, if put to intereſt, would in that time and at the rate per cent. for which the diſcount is to be made, amount to the ſum or debt, then due.

Rule. As the amount of 100l. for the given rate and time, is to 100l: So is the given ſum or debt, to the preſent worth.

Subtract the preſent worth from the given ſum, and the remainder will be the diſcount required.

Or,

As the amount of 100l. for the given rate and time, is to the intereſt of 100l. for that time: So is the given ſum or debt to the diſcount required.

Examples.

1. What is the diſcount of 635l. 17s. due two years hence, at 5½ per cent. per annum?

Int of £100 per annum. } £. s.
5 10
2 years.

11
Add 100

£. £. s.
As £111 : 11 :: 635 17
20 20

2220 12717
11

12717
12717

222|0)13988|7(63£ disount.
1332

668
666

27
20

222|0)540(2
12

222|0)648|0(2
444

204 *Anſ.* £63 0 2¼d.

£. £. £. s. £. s. d.
Or, as 111 : 100 :: 635 17 : 572 16 9¼ *preſent worth*

£. £. £.
And 635 17—572 16 9¼=63 0 2¾ *diſcount.*

2. What is the preſent worth of 350l. payable in half a year, diſcounting at 6l. per cent. per annum ?

Anſ. 339l. 16 1

3. What

3. What is the preſent worth of 65l. due 15 months hence, at 6l. per cent per annum ?

Anſ. 60l. 9 3¾.

4. What is the diſcount of 97l. 10s. due January 22d, this being September 7th, reckoning intereſt at 5l. per cent. ? *Anſ.* 1l. 15 11.

5. Bought a quantity of goods for 250l. ready money, and ſold them for 300l. payable in 9 months ; what was the gain, in ready money, ſuppoſing the diſcount to be made at 6l. per cent. ?

Anſ. 37l. 1 7½.

BARTER

Is the exchanging of one commodity for another, and teaches traders to proportion their quantities without loſs.

CASE I.

When the quantity of one commodity is given, with its value, or that of its integer, that is of 1lb. 1Cwt. 1 yd. &c. as alſo the value of the integer of ſome other commodity to be given for it, to find the quantity of this ; or, having the quantity thereof given, to find the rate of ſelling it.

RULE. Find the value of the given quantity by the conciſeſt method, then find what quantity of the other at the rate propoſed, you may have for the ſame money : Or, if the quantity be given, find from thence the rate of ſelling it.

EXAMPLES.

1. How much tea, at 9ſ6 per lb. muſt be given in barter for 156 gallons of wine, at 12s. 3½d. per gallon ?

3d.

| 3d | ¼ | 156 gallons.
| ½ | ¼ | 12

1872
39
6 6

1917 6
96=114d. 12

23010

d. lb. d.
As 114 : 1 :: 23010
1

114)23010(201
228

210
114

96
16

576
96

114)1536(13 $\frac{34}{114}$ *Anſ.* 201lb. 13$\frac{24}{114}$oz.
114

396
342

54

2. How much cloth, at 15s. 8d. per yard, muſt be given for 5Cwt. 8 qrs. 19lb. of ſteel, at 5 guineas per per Cwt. ?
Anſ. 50yds. 3 qrs. 2 nails.

3. Suppoſe A has 350 yards of linen at 1s. 4d. per yard, which he would truck with B for ſugar at 25s. 6d. per Cwt. ; how much ſugar will the linen come to?

Cwt. qr. lb
Anſ. 18 1 5$\frac{3}{4}$

4. A

4. A has broadcloth, at £12 10s. per piece, and B has mace, at 8s. per lb.; how many pounds of mace muſt B give A for 35 pieces of cloth? *Anſ.* 1093¾lb.

5. A has 7½ Cwt. of ſugar, at 8d. per lb. for which B gave him 12½ Cwt. of flour; what was the flour rated at per lb.? *Anſ.* 4¾d.

CASE II.

If the quantities of two commodities be given, and the rate of ſelling them, to find, in caſe of inequality, how much of ſome other commodity muſt be given.

RULE. Find the ſeparate values of the two given commodities; ſubtract the leſs from the greater, and the difference will be the amount of the third commodity, whoſe quantity and rate may be eaſily found.

EXAMPLES.

1. Two merchants barter; A has 30 Cwt. of cheeſe, at 23s. 6d. per Cwt. and B has 4 pieces of broadcloth, at 3l. 15s. per piece; which muſt receive money? and how much? *Anſ.* B muſt pay A 1l. 10s.

2. A and B would barter; A has 150 buſhels of wheat at 5s. 9d. per buſhel; for which B gives 65 buſhels of barley, worth 2s. 10d. per buſhel, and the balance in oats, at 2s. 1d. per buſhel; what quantity of oats muſt A receive from B? *Anſ.* 325⅗ buſhels.

CASE III.

Sometimes, in bartering, one commodity is rated above the ready money price; then to find the bartering price of the other, ſay, As the ready money price of the one is to its bartering price, ſo is that of the other, to its bartering price: Next find the quantity required, according to either the bartering or ready money price.

Examples.

1. A has ribbands at 2s. per yard ready money; but in barter he will have 2s. 3d. B has broadcloth at 32s. 6d. per yard, ready money: At what rate muſt B value his cloth per yard, to be equivalent to A's bartering price? and how many yards of ribband, at 2s. 3d. per yard, muſt then be given by A for 488 yards of B's broadcloth?

Anſ. B's broadcloth at 1l. 16s. 6¼d. per yard—7930 yards of ribband.

2. A and B barter; A has 150 gallons of brandy at 7s. 3d. per gallon ready money; but in barter he will have 8s. per gallon: B has linen at 3s. 6d. per yard ready money; how muſt B ſell his linen per yard, in proportion to A's bartering price? and how many yards are equal to A's brandy?

Anſ. Barter price is 3s. 10¼d. and he muſt give A 311 yards 3qr. 3n.

3. P. and Q barter; P has linen at 3s 7d. per yard; but in barter will have 3s. 10d. Q delivers him broadcloth at 1l 16s. 6d per yard, worth only 1l. 13s. per yard; pray, which has the advantage in barter? and how much linen does P give Q for 148 yards of broadcloth?

Yd. Yds. s.
As 1 : 36/6 :: 148 : 5402 price of the broadcloth. As 3/10 : 1yd. :: 5402s. : 1409$\frac{6}{23}$yds. of linen.—Q has the advantage; for, as 3/7 : 3/10 :: 33s. : 35/3$\frac{27}{43}$ his proportional price.

4. A has 200 yards of linen, at 1s. 6d. ready money per yard, which he barters with B at 1s. 9d. per yard, taking buttons at 7½d. per groſs, which are worth but 6d; how many groſs of buttons will pay for the linen?

linen? who gets the beſt bargain, and by how much, both in the whole and per cent?

Yd. d. Yds. d. d. Groſs. d. Groſs.
As 1 : 21 :: 200 : 4200. As 7½ : 1 :: 4200 : 560.
Yd. d. Yds. £.
As 1 : 18 :: 200 : 15 value of A's linen.
Gr. d. Gr. £.
As 2 : 6 :: 560 : 14 value of B's goods. So that B gained 1l. of A.

£. £. £. £.
As 14 : 1 :: 100 : 7 2s. 10d. per cent.

LOSS AND GAIN

Is an excellent rule, by which merchants and traders diſcover their profit, or loſs, per cent. or by the groſs: It alſo inſtructs them to raiſe or fall the price of their goods, ſo as to gain or loſe ſo much per cent. &c.

CASE I.

To know what is gained or loſt per cent.

Rule. Firſt ſee what the gain or loſs is, by Subtraction; then, As the price it coſt, is to the gain or loſs; ſo is 100l. to the gain or loſs per cent.

Examples.

1. If I buy ſerge at 5s. per yard, and ſell it again, at 5s. 8d. per yard; what do I gain per cent. or in laying out 100l.?

s. d.
Sold for 5 8 [See proceſs next page.]
Coſt 5 0

8d. gain per yard.

N. B. The firſt queſtions in the ſeveral Caſes, ſerve to elucidate each other.

As

d. d. £.
As 60 : 8 :: 100
8

60)800(13
60

200
180

20
20

60)400(6
360

40
12

60)480(8
480

2. If I buy ſerge at 5/8 per yard, and ſell it again at 5s. per yard what do I loſe per cent. or in laying out 100l. ?

s. d. d. d. £. £. s. d.
Coſt 5 8 As 68 : 8 :: 100 : 11 15 3½ (Anſ.
ſold for 5 0

8d. Loſs per yard.

Anſ. 13l. 6/8.

3. If I buy a Cwt. of tobacco for 9l. 6/8, and ſell it again at 1s. 10d. per lb. do I gain or loſe ? and what per cent. ?

£. s. d.
Sold for 10 5 4
Coſt 9 6 8

£. s. £0 18 8 gained in the groſs.
2d. | 1/12 | 11 4 value at 2s. per lb.

0 18 8 value at 2d. per lb.

10 5 4 value at 1s. 10d. per lb.

£. s. d. s. d. £. £.
As 9 6 8 : 18 8 :: 100 : 10 Anſ. 10l. per cent.

4 A

4. A draper bought 60 yards of cloth at 28s. per yard, and 38 yards of ditto, at 14s. per yard and sold them one with another, at 26s. per yard; did he gain or lose? and what per cent.?

yds. s. £. yds. yd. s. yds. £. s.
As 1 : 28 :: 60 : 84 As 1 : 26 :: 98 : 127 8

yd. s. yds. £. s. £. s.
As 1 : 14 :: 38 : 26 12 Sold for 127 8
Prime cost 110 12
Whole prime cost 110 12£
Gain in the gross 16 16

£. s. £. s. £. £. s. d.
As 110 12 : 16 16 :: 100 : 15 3 9$\frac{1}{7}$ per cent.

5. Bought sugar at 6½d. per lb. and sold it at 2l. 3s. 9d. per Cwt.; what was the gain or loss per cent.?

lb. lb.
As 1 : 6½d. :: 112 : £3 0s. 8d.
Prime cost £3 0 8 per Cwt. £. s. d. s. d. £. £. s. d.
Sold at 2 3 9 per Cwt. As 3 0 8 : 161 :: 100 : 27 17 8$\frac{1}{2}$
(Loss per cent. Ans.
Loss £0 16 11 in the whole.

6. At 2½d in the shilling profit; how much per cent.?

s. d. £. £. s. d.
As 1 : 2½ :: 100 : 20 16 8 *Ans.*

7. At 4s. 6d. in the pound profit; how much per cent.?

£. s. d. £. £. s.
As 1 : 4 6 :: 100 : 22 10 *Ans.*

8. If I buy candles, at 1s. 6d. per lb. and sell them again, at 2s. per lb. and allow 3 months for payment; what do I gain per cent.?

d. d. £. £. s. d.
As 18 : 24 :: 100 : 133 6 8; then by Dis.

Mo. £. Mo. £. s.
As 12 : 6 :: 3 : 1 10

£. s. £ s. £. s. d. £. s. d.
Then, as 101 10 : 1 10 :: 133 6 8 : 1 19 4$\frac{1}{2}$, which taken from 133l. 6s. 8d. leaves £131 7s. 3½d. therefore, *Ans.* £31 7s. 3½d.

9. If

9. If I buy cloth at 13s. per yard, on 8 months credit, and fell it again at 12s. ready money, do I gain or lose and what per cent. ?

Mo. £. Mo £. £. s. £. s. d.
As 12 : 6 :: 8 : 4. As 104 : 13 :: 100 : 12 6

So that 13s. on 8 months credit, at 6l. per cent. is equal to 12s. 6d. ready money; then,

s. d. s. d. d. £. £.
Prime coſt 12 6 ready money } As 12 6 : 6 :: 100 : 4
Sold at 12 0 ready money }
Loſt 0 6 in the yard. } *Anſ.* loſt 4l.

In caſting up the amount of goods bought, imported or exported; to the prime coſt of ſuch goods we muſt add all the charges upon them, in order to fix the price they ſtand us in.

10. Suppoſe I import from France 12 bales of cloth, each bale containing 10 pieces, which with the charges there, amounted to 108l.; I pay duty here 5s. 6d. per piece, for freight 3l. 10s. and the porterage 7s. 6d.; what does it ſtand me in per piece? and how muſt I ſell it per piece to gain 10l. per cent.?

12 bales
Each 10 pieces.
In all 120 pieces, at 5s. 6d.

£.
First coſt 108 0 0
Duty 33 0 0
Freight 3 10 0
Porterage 0 7 6
Whole coſt £144 17 6

Pieces. £. s. d piece.
As 120 : 144 17 6 :: 1

1
12 } 144 17 6 diviſor,
10 }
12 1 5½

£. £. £. s. d.
As 10|0 : 1|0 :: 1 4 1¾
10)1 4 1¾ coſt per piece.
2 5 gain per piece
at 10 per cent.
£. 1 6s. 6¾d.

£. 1 4 1¾
Anſ. Prime coſt per piece, 1l. 4 1¾
And I muſt ſell it at 1l. 6 6¾ per piece.

CASE

CASE II.

To know how a commodity muſt be ſold, to gain or loſe ſo much per cent.

RULE. As 100l. is to the price; ſo is 100l. with the profit added or loſs ſubtracted, to the gaining or loſing price.

EXAMPLES.

1. If I buy a quantity of ſerge, at 5s. per yard; how muſt I ſell it per yard to gain 13l. 6s. 8d. per cent?

```
   £.  s.   £.  s. d.        Or thus,
As 100 : 5 :: 113 6 8      £.  s.  d.
    20        20             113  6  8
   ----      ----                    5
  2000      2266            ----------
    12        12        s. 5|66 13  4
   ----      ----             12
 24000     27200           ------
               5            792
              ----   Add 8=⅓ of 12=13s. 4d.
 24000)136,000(5           ----
       120                 d. 8|00
       ---
        16                  s.  d.
        12      Anſ.        5   8 per yard.
       ---
24,000)192,000(8
       192
       ---
         000
```

2. If a barrel of powder coſt 4l. how muſt it be ſold to loſe 10 per cent.?

As

Or thus,

£. £. £. £. s.
As 100 : 4 :: 90 : 3 12 *Anſ.*

90
4

£3,60
20

s. 12,00

3. Bought cloth at 15s. per yard, which not proving ſo good as I expected, I am content to loſe 17½l. per cent. by it; how muſt I ſell it per yard?

£. s. £. s. d.
As 100 : 15 :: 82½ : 12 4½ *Anſ.* 12s. 4½d.

4. If 120lb. of ſteel coſt 7l.; how muſt I ſell it per lb. to gain 15½l. per cent.?

lb. £. lb. s. d. £. s. d. £. s. d.
As 120 : 7 :: 1 : 1 2 As 100 : 1 2 :: 115½ : 1 4
(per lb. *Anſ.*

5. Bought fiſh in Newburyport, at 10s. per quintal, and ſold it at Philadelphia at 17s. 6d. per quintal; now, allowing the charges to be 2s. 6d. per quintal, and conſidering I muſt looſe 20l. per cent. by remitting my money home; what do I gain per cent.?

s. d.
Selling price 17 6 Philadelphia currency per quintal.
Charges = 2 6 Ditto.

17 0 Ditto.

£. s. £. s.
As 100 : 15 :: 80 : 12 New England currency.
Sold at 12s. per quintal.
Bought at 10s. per quintal.

s. s. £. £.
Gained 2s. per quintal—As 10 : 2 :: 100 : 20 per
(cent. gained, *Anſ.*

6. Bought 50 gallons of brandy, at 4s. per gallon, but, by accident, 10 gallons leaked out; at what

what rate muſt I ſell the remainder per gallon, to gain upon the whole prime coſt, at the rate of £10 per cent. ?

50 gall. at 4s. per gall. = £10
10 gallons leaked out.
40 gallons remain

Gal. £. Gal. s.
As 40 : 10 :: 1 : 5
£. s. £. s. d.
As 100 : 5 :: 110 : 5 6 *Anſ.*

CASE III.

When there is gained or loſt per cent. To know what the commodity coſt.

RULE. As £100, with the gain per cent. added, or loſs per cent. ſubtracted, is to the price; ſo is £100 to the prime coſt.

EXAMPLES.

1. If 1 yard of cloth be ſold at 5s. 8d. and there is gained £13 6 8 per cent; what did the yard coſt ?

£. s. d. s. d. £.
As 113 6 8 : 5 8 :: 100
20 12 68

2266 68 800
12 600

27200 272,00)68|00(0
20

272,00)1360|00(5s. prime coſt, *Anſ.*
1360

2. If 12 yards of cloth are ſold at 15s. per yard, and there is £7 10s. loſs per cent. in the ſale; what is the prime coſt of the whole ?

Yd. s. Yds. £. £. s. £. £. £. s. d.
As 1 : 15 :: 12 : 9. As 92 10 : 9 :: 100 : 9 13 6 (*Anſ.*

3. If 19½Cwt. ſugar be ſold, at £4 5s. per Cwt. and I gain £15 per cent.; what did it coſt per Cwt.?

£. £. s. £. £. s. d.
As 115 : 4 5 :: 100 : 3 13 10¾ *Anſ.*

CASE IV.

If by wares ſold at ſuch a rate, there is ſo much gained or loſt per cent. To know what would be gained or loſt per cent. if ſold at another rate.

RULE. As the firſt price is to £100, with the profit per cent. added, or loſs per cent. ſubtracted; ſo is the other price, to the gain or loſs per cent. at the other rate.

N. B. If your anſwer exceed £100, the exceſs is your gain per cent. but if it be leſs than £100, that deficiency is the loſs per cent.

EXAMPLES.

1. If cloth ſold at 5s. 8d. per yard, be £13 6s. 8d. profit per cent.; what gain or loſs per cent. ſhall I have if I ſell the ſame at 5s. per yard?

s. d. £ s. d. s.
As 5 8 : 113 6 8 :: 5
12 20

68 2266
12

27200
5

68)136000(200,0 100—100=0 *Anſ.* I neither
136 gain nor loſe.
£100
,000

2. If

2. If cloth ſold at 4s. per yard, be 10 profit; what ſhall I gain or loſe per cent. if 6d. per yard?

s. £. s. d. £.
As 4 : 110 :: 3 6 : 96¼ £. £. £.
Then, 100—96¼=3¾ per ce

3. I ſold a watch for 50l. and by ſo doing 17l. per cent. whereas I ought, in trading, to cleared 20l. per cent.; how much was it ſold unde real value?

£. £. £. £. s. d. £. £. s. d.
As 83 : 50 :: 100 : 60 4 9¼ As 100 : 60 4 9¼
£. £. s. d. £. s. d. £. £. s. d.
120 : 72 5 9¼ then, 72 5 9¼—50=22 5 9¼ *Anſ.*

EQUATION OF PAYMENTS

Is the finding of a time to pay at once, ſeveral debts due at different times, ſo that no loſs ſhall be ſuſtained by either party.

RULE 1.* Multiply each payment by the time at which it is due; then divide the ſum of the products by the ſum of the payments, and the quotient will be the equated time, or that required.

EXAMPLES.

1. A owes B 380l. to be paid as follows, viz. 100l. in 6 months, 120l. in 7 months, and 160l. in 10 months; what is the equated time for the payment of the whole debt?

100

* This rule is founded upon a ſuppoſition, that the ſum of the intereſts of the ſeveral debts, which are payable before the equated time, from their terms to that time, ought to be equal to the ſum of the intereſts of the debts payable after the equated time, from that time to their terms.

100 × 6 = 600
120 × 7 = 840
160 × 10 = 1600

100 + 120 + 160 = 380)3040(8 months, *Anſ.*
3040

2. A owes B 104l. 15s. to be paid in $4\frac{1}{2}$ months, 161l. to be paid in $3\frac{1}{2}$ months, and 152l. 5s. to be paid in 5 months: what is the equated time for the payment of the whole? *Anſ.* 4 months and 8 days.

3. There is owing to a merchant 698l. to be paid 178l ready money, 200l. at 3 months, and 320l. in 8 months; I demand the indifferent time for the payment of the whole? *Anſ.* $4\frac{1}{2}$ months.

4. The ſum of 49l. 1s. 6d. is to be paid $\frac{1}{2}$ at 6 months, $\frac{1}{3}$ at 8 months, and $\frac{1}{6}$ at 10 months; what is the mean time for the payment of the whole? *Anſ.* $7\frac{2}{3}$ months.

RULE 2. See by Rule 1ſt, at what time the firſt man, mentioned, ought to pay in his whole money; then as his money is to its time, ſo is the other's money to his time inverſely, which, when found, muſt be added to or ſubtracted from, the time at which the ſecond ought to have paid in his money, as the caſe may require, and the ſum, or remainder, will be the true time of the ſecond's payment.

EXAMPLES.

1. A is indebted to B 150l., to be paid 50l. at 4 months, and 100l. at 8 months: B owes A 250l. to be paid at 10 months: It is agreed between them, that A ſhall make preſent pay of his whole debt, and that B ſhall pay his ſo much the ſooner, as to balance that favour; I demand the time at which B muſt pay the 250l. reckoning ſimple intereſt?

$50 \times 4 = 200$
$100 \times 8 = 800$

$50 + 100 = 150)1000(6\frac{2}{3}$ months, A's equated time.
900

100

£. mo. £. mo. mo. mo. mo.
As 150 : $6\frac{2}{3}$ :: 250 : 4 then 10—4=6 time of B's payment.

2. A merchant has £1200 due to him, to be paid $\frac{1}{6}$ at 2 months, $\frac{1}{3}$ at 3 months, and the reſt at 6 months; but the debtor agrees to pay $\frac{1}{2}$ down; how long may the debtor detain the other half, ſo that neither party may ſuſtain loſs?

mo. mo.
$\frac{1}{6} \times 2 = 0\frac{4}{3}$
$\frac{1}{3} \times 3 = 1$
$\frac{1}{2} \times 6 = 3$
Equated time $4\frac{1}{3}$.

Now, as $\frac{1}{2}$ was paid $4\frac{1}{3}$ months before it was due, it is reaſonable that he ſhould detain the other $\frac{1}{2}$ $4\frac{1}{3}$ month, after it became due, which, added, gives $8\frac{2}{3}$ months, the true time for the ſecond payment.

COMMISSION OR FACTORAGE*

Is an allowance of ſo much per cent. to a factor, or correſpondent abroad, for buying and ſelling goods, for his employer.

Examples.

1. What comes the commiſſion on £539 12/9 to, at $4\frac{1}{2}$ per cent.?

539

* The method of working queſtions in this Rule, Brokerage and the firſt caſe of Inſurance, is the ſame as in Simple Intereſt.

£.	s.	d.
539	12	9
		4½
2158	11	0
Product of ½ = 269	16	4½
£24128	7	4½
	20	
s. 5167		
	12	
d. 8108.		

2. My factor receives £1008 to lay out after having deducted his commiſſion of £5 per cent.; what does his commiſſion amount to?

Here, as his commiſſion is to be deducted from the given ſum, it is evident that I ought not to pay him commiſſion on his own money (which however is often unjuſtly practiſed), therefore,

£. £. £. £.
As 105 : 5 :: 1008 : 48 *Anſ.*

3. My correſpondent writes me that he has purchaſed goods to the value of £673 12s.; what does his commiſſion on that ſum amount to, at £3½ per cent.?

Anſ. £23 11 6.

BROKERAGE

Is an allowance of ſo much per cent. to a perſon called a Broker, for aſſiſting merchants or factors in purchaſing or ſelling goods.

EXAMPLES.

1. What is the brokerage upon £525 10s. at 5s. or £¼ per cent.?

5s.

5s.	¼	£. s. 525 10
		1,31 7 6
		20
		6,27
		12
		3,30
		4
		1,20

5 shillings being an aliquot part of £1, divide by that part, and the quotient is the answer.

Anſ. £1 6 3¼

2. What is the brokerage upon £673 16s. at £½ per cent.? *Anſ.* £4 4 2½

3. If a broker fell goods to the amount of £709 19s. 11d.; what is his demand, at £1½ per cent.?

Anſ. 10l. 12 11¾

BUYING AND SELLING STOCKS.

Stock is a general name for the capitals of trading companies, banks, &c. and the buying and ſelling certain ſums of money in thoſe funds, is not unuſual.

Examples.

1. What is the purchaſe of 275l. 15s. bank ſtock, at 74½l. per cent.?

			£. s.
£74½ want 25½l. of 100l. therefore, take parts for the deficiency, and ſubtract the ſum of thoſe parts from the given ſum.	£20	⅕	275 15 0
	£5	¼	55 3 0
	£½	1/10	13 15 9
			1 7 6¾
		Subtract	70 6 3¾
		Anſ.	£205 8 8¼

Or,

Or, If I had taken parts for 74½l. the rate per cent. then the ſum of the ſeveral quotients would have been the anſwer as above.

When the price is above 100, take parts for the ſurplus of the price above 100, and add them to the given ſum for the anſwer.

2. What is the purchaſe of 1029l. 10s. 6d. bank ſtock, at 110¼l. per cent. ?

£.		£. s. d.	
10	1/10	1029 10 6	at 100 per cent.
£¼	1/40	102 19 0½	at 10 per cent.
		2 11 5½	at ¼ per cent.
		Anſ. £1135 1 0	at £110¼ per cent.

3. What does 1600l. capital ſtock in the Maſſachuſetts bank come to, at 120¾l. per cent. ?

Anſ. 1922l.

POLICIES OF INSURANCE.

Inſurance is a ſecurity or aſſurance, by means of a Writ called a policy, to indemnify, the inſured of ſuch loſſes as ſhall be ſpecified in the policy ſubſcribed by the inſurer or inſurers, by which the underwriters oblige themſelves to make good and effectual the property inſured, in conſideration of a certain premium at a ſtipulated rate per cent. (which varies according to the riſk) to be immediately paid down, or otherwiſe ſecured according to the tenor of the agreement.

The average loſs is 10 per cent.—that is, if the inſured ſuffer any damage or loſs, not exceeding 10 per cent. he bears it himſelf, and the inſurers are free.

A policy ſhould be taken out for a ſum ſufficient to cover the principal and premium, and the buſineſs of this rule is, in general to calculate what that ſum ſhould be.

CASE

CASE I.

When the premium at a certain rate per cent. for inſuring a ſum, is required, the operation is the ſame as in intereſt or commiſſion.

1. What is the premium upon £537 15 9 at 6½ per cent. ?

£	s.	d.	
537	15	9	
			6½
3226	14	6	
½=268	17	10½	
34|95	12	4½	
20			
19|12			
12			
1|48			
4			
1|94			

Anſ. £34 19s 1¾d.

CASE II.

To find the ſum for which a policy ſhould be taken out to cover a given ſum.

RULE. Take the premium from £100, and ſay, as the remainder is to £100; ſo is the ſum adventured to the policy.*

1. It

* Now, it is plain that, if I want to recover £92, I muſt, in this caſe, inſure upon £100; therefore, to recover £759 I muſt inſure upon £825, for when 8 per cent. for premium is deducted, I ſhall have £759 remaining neat.

For £825 = ſum inſured upon at 8 per cent.
66 = Premium to be deducted.

£759 = The firſt outſet.

1. It is required to cover £759, premium 8 per cent; for what ſum muſt the policy be taken?

100
8

92 : 100 :: 759
100

92)75900(£825 *Anſ.*
736

230
184

460
460

2. A merchant ſent a veſſel and cargo to ſea, valued at £1525; what ſum muſt the policy be taken out for, to cover his property, premium 19½ per cent.?

100
19,5

80,5 : 100 :: 1525 : £1894 8 2½ *Anſ.*

CASE III.

When a policy is taken out for a certain ſum in order to cover a given ſum: To find the premium, ſay; As the policy is to the covered ſum; ſo is £100 to a fourth number, which, being taken from £100, will leave the premium.

If a policy be taken out for £1250 to cover £500; what is the premium per cent.?

1250 : 500 :: 100
100

1250)50000(40 and £100—40=£60 *Anſ.*

CASE

CASE IV.

When the policy for covering any ſum and the premium per cent. are given to find the ſum to be covered.

RULE. Deduct the premium per cent. from 100, and ſay, As 100 is to the remainder; ſo is the policy to the ſum required to be covered.

If a policy be taken out for £1250 at 60 per cent.; what is the adventure, or ſum to be covered?

100
60

100 : 40 :: 1250
40

100)50000(£500 *Anſ.*

COMPOUND INTEREST.

Compound Intereſt is that which ariſes from the intereſt being added to the principal, and (continuing in the hands of the borrower) becomes a part of the principal, at the end of each ſtated time of payment.

GENERAL RULE. Find the amount of the given principal, for the time of the firſt payment, by ſimple intereſt; next find the intereſt of that ſum, or principal and add it as before, and thus proceed for any number of years, ſtill accounting the laſt amount as the principal for the next payment. The given principal being ſubtracted from the laſt amount, the remainder will be the compound intereſt.

EXAMPLES.

1. What will £480 amount to in 3 years, at £6 per cent. per annum?

Principal.

Principal. 480
Rate of int. 6

£28|80
20

s. 16|00
Prin. 1ſt year, 480
Int. of ditto, 28 16

Prin. 2d year, 508 16
6

£30|52 16
20

s. 10|56
12

d. 6|72
4

qrs. 2|88
Prin. 2d year, 508 16 0
Int. of ditto, 30 10 6½

Prin. of 3d yr. 539 6 6½
6

£32|35 19 3
20

s. 7|19
12

d. 2|31
4

qr. 1|24

Prin. 3d year, £539 6 6½
Int. of ditto, 32 7 2¼

Amount, *Anſ.* £571 13 8¾
Sub. 1ſt prin. 480

Compound int. for 3 years. } 91 13 8¾

2. What is the compound intereſt of £740 for 6 years, at £4 per cent. per annum?
Anſ £196 6 8½.

3. What will £150 amount to in a year, at £2 per cent. per month?
Anſ. £190 4 5.

When

When the rate is at 5 per cent. per annum.

1. Divide the principal by 20, and this quotient added to the principal, will be the amount for the firſt year, and the principal for the ſecond.
2. In like manner find the amount for every ſucceeding year.

When the rate is at 6 per cent. per annum, you may

1. Divide the principal by 20, and that quotient by 5: Theſe quotients, added to the principal, will be the amount for the firſt year, and the principal for the ſecond.
2. In like manner obtain the amount for every ſucceeding year.

EXAMPLES.

What is the amount of 480l. at 6 per cent per annum, for 4 years?

20)480
5) 24
4 16

20)508 16 amt. of the 1ſt yr.
5) 25 8 $9\frac{1}{2}$
5 1 9

20)539 6 $6\frac{1}{2}$ ditto of 2d.
5) 26 19 $3\frac{3}{4}$
5 7 $10\frac{1}{4}$

20)571 13 $8\frac{1}{2}$ do. of 3d.
5) 28 11 8
5 14 4

£605 19 $8\frac{1}{2}$ do. of 4th. *Anſ.*

Of the ſame ſum at 5 per cent. per annum, for 4 years?

20)480
24

10)504 amount of 1ſt yr.
25 4

20)529 4=ditto of 2d.
26 9 $2\frac{1}{4}$

20)555 13 $2\frac{1}{4}$=do. 3d.
27 15 $7\frac{3}{4}$

£583 8 10= do. of (4th. Anſ.

COMPOUND INTEREST BY DECIMALS.

A TABLE *of the amount of* 1*l. at* 6 *per cent. per annum, for months.*

Mo.	£. *dec. part.*	*Mo.*	£. *dec. part.*	*Mo.*	£. *dec part*
1	1,00487	5	1,02457	9	1,04467
2	1,00976	6	1,02956	10	1,04975
3	1,01467	7	1,03457	11	1,05486
4	1,01961	8	1,03961	12	1,06

A TABLE *of the amount of* 1*l. from* 1 *day to* 31 *days, at* 6 *per cent. per annum.*

days.	£. *dec. part.*	*days.*	£. *dec. part.*	*days.*	£. *dec. parts.*
1	1,00010	12	1,00197	22	1,00361
2	1,00032	13	1,00213	23	1,00378
3	1,00049	14	1,00230	24	1,00394
4	1,00065	15	1,00246	25	1,00410
5	1,00082	16	1,00263	26	1,00427
6	1,00098	17	1,00279	27	1,00443
7	1,00115	18	1,00295	28	1,00460
8	1,00131	19	1,00312	29	1,00476
9	1,00147	20	1,00328	30	1,00493
10	1,00164	21	1,00345	31	1,00509
11	1,00180				

A TABLE *of the amount of* 1*l. at* ½ *per cent. per month, as practised at the banks.*

Mo.	£. *dec parts*	*Mo*	£. *dec. parts.*	*Mo.*	£. *dec. pts*
1	1,005	5	1,025	9	1,045
2	1,01	6	1,03	10	1,05
3	1,015	7	1,035	11	1,055
4	1,02	8	1,04	12	1,06

CASE I.

When the principal, the rate of interest, and time are given, to find either the amount or interest.

RULE 1. Find the amount of 1*l.* for 1 year, at the given rate per cent.

2. Involve

2. Involve the amount, thus found, to such power as is denoted by the number of years—or, in Table 1st at the end of annuities, under the rate and against the given number of years, you will find the power *.

3. Multiply this power by the principal, or given sum, and the product will be the amount required, from which, if you subtract the principal, the remainder will be the interest.

EXAMPLES.

1. What is the compound interest of 600l. for 4 years, at 6 per cent. per annum?

1,06 = { Amount of 1l. for 1 year. at 6 per cent. per annum.

Multiply by 1,06

1,1236=2d power.

Multiply by 1,1236

1,16247696=4th power.

Multiply by 600=the principal.

757,486176 00=amount.

Subt. 600

157,48617 6=157l. 9s. 8½d.=Int. required.

By

* The amounts of 1l. in this table, are so many powers of the amount of 1l. for 1 year, whose indices are denoted by the number of years.

Note. When the given time consists of years and months, or years, months and days; First seek the amount of 1l. in the Table for years, then, in the Table of months, &c. multiply these several amounts and the principal continually together, and the last product will be the amount required.

Thus, if the amount of 480l in 5½ years, at 6 per cent. per annum, were required; the amount of 1l. for 5 years= 1,33822 ditto for 6 months=1,02956. Now, 1,33822 × 1,02956×480=£661,2341. Ans.

By TABLE I.

Tabular amount of 1l. for 4 years, at 6 per cent. per annum, } = 1,2624769

Multiply the principal = 600

Amount = 757,4861400

Another way of working Compound Intereſt for years, months, and days which is much more conciſe than the preceding method.

RULE. To the logarithm of the principal, found in any Table of logarithms, add the ſeveral logarithms, anſwering to the number of years, months, and days, found in the following Tables, and their ſum will be the logarithm of the amount for the given time, which being found in any table of logarithms, the natural number correſponding thereto will be the anſwer.

Logarithmick Tables at 6 per cent. per annum, for years, months, and days.

Yrs	dec pts	Yrs	dec pts	Yrs	dec pts	Yrs	dec pts	Yrs	dec pts
1	,025300	11	,278306	21	,531326	31	,783506	1	,002166
2	,050612	12	,303672	22	,556732	32	,809762	2	,004321
3	,075918	13	,328978	23	,582038	33	,835098	3	,006466
4	,101224	14	,354284	24	,607344	34	,860404	4	,0086
5	,126530	15	,379690	25	,632650	35	,885710	5	,010724
6	,151836	16	,404896	26	,657956	36	,911016	6	,012837
7	,177142	17	,430202	27	,683262	37	,936322	7	,01494
8	,202148	18	,455508	28	,708568	38	,961628	8	,017033
9	,227754	19	,480814	29	,733974	39	,986934	9	,019116
10	,25306	20	,50612	30	,75938	40	1,01224	10	,021189
								11	,023252

days	D	days	D	days	D	days	D
1	,000071	8	,000571	14	,000999	20	,001426
2	,000143	9	,000642	15	,00107	21	,001497
3	,000215	10	,000713	16	,001142	22	,001568
4	,000287	11	,000785	17	,001213	23	,001639
5	,000358	12	,000857	18	,001284	24	,00171
6	,000429	13	,000928	19	,001355	25	,001781
7	,0005						

days	D
26	,001852
27	,001923
28	,001994
29	,002065
30	,002136
31	,002207

What

What is the amount of 132l. 10s. at 6 per cent. per annum, for 9 years, 8 months, and 15 days?

To the Log. of £132,5 = 2,12222

Add. { Log. for 9 years = ,22775
ditto for 8 months = ,01703
ditto for 15 days = ,00107

2,36807 the

nearest to which, in the Table of Logarithms, is 2,36810, and the natural number answering thereto is 233,4 = 233l. 8s. *Anſ.*

CASE II.

When the amount, rate and time are given, to find the principal.

RULE. Divide the amount by the amount of 1l. for the given time, and the quotient will be the principal.

Or, If you multiply the preſent value of 1l. for the given number of years, at the given rate per cent. by the amount, the product will be the principal, or preſent worth.

EXAMPLE.

What is the preſent worth of 757l. 9s. 8½d. due 4 years hence, diſcounting at the rate of 6l. per cent. per annum?

By Tab. 1ſt, divide by the tabular amount of 1l. for 4 years. } = £1,26247 69)757,48614 00(
(600 Anſ.

By TABLE II.

Amount = 757,48614

Mult. by the preſent worth of 1l. for 4 years, at 6 per cent. per annum. } = ,79,20936

Anſ. 599,99992358704 + = 600l.

CASE III.

When the principal, rate and amount are given, to find the time.

RULE. Divide the amount by the principal, then divide this quotient by the amount of 1l. for 1 year, this quotient by the ſame till nothing remain, and the number of the diviſions will ſhow the time.

Or, Divide the amount by the principal, and the quotient will be the amount of 1l. for the given time, which ſeek under the given rate in Table 1ſt, and in a line with it you will ſee the time.

EXAMPLE.

In what time will 600l. amount to 757l. 9s. $8\frac{1}{2}$d. at 6 per cent. per annum, compound intereſt?

Divide the amount by the principal, } =600)757,486176(1,26247696 (=quotient to be divided

by 1,06 till it can be had no more; or you may find it in Table 1ſt, under 6 per cent. and againſt 4 years.

Divide by 1,06)1,26247696

1,06)1,191016

1,06)1,1236

1,06)1,06

1

Four diviſions ſhow the time to be 4 years.

CASE IV.

When the principal, amount and time are given, to find the rate per cent.

RULE. Divide the amount by the principal, and the quotient will be the amount of 1l. for the given time: then, extract ſuch root as the time denotes, and that root will be the amount of 1l. for 1 year, from

from which subtract unity, and the remainder will be the ratio.

Or, Having found the amount of 1l. for the time, as above directed, look for it in Table 1ſt, even with the given time, and directly over the amount you will find the ratio.

Examples.

At what rate per cent. per annum wil 600l. amount to 757l. 9s. 8½d. in 4 years?
600)757,48614(1,2624769.—Now the time being 4 years the 4th root of this quotient minus 1 will be the ratio.

. . . .

1,26247690)1,123599+and 1,123599(1,05999+ and 1,05999—1=,06 *Anſ.*

DISCOUNT BY COMPOUND INTEREST.

CASE I.

The ſum or debt to be diſcounted, the time and rate given to find the preſent worth.

Rule. Divide the debt by that power of the amount of 1l for 1 year, denoted by the time, and the quotient will be the preſent worth, which, ſubtracted from the debt will leave the diſcount.

Examples.

1. What is the preſent worth, and diſcount, of 600l. due 3 years hence, at 6l. per cent. per annum compound intereſt?
Divide by $1{,}06^3=1{,}191016$)600,00000(503,7741= £503 15ſ5¼d preſent worth; and £600—£503 15 5¼= £96 4s. 6¾d.=Diſcount.

By

By TABLE 2d. In this table, correſponding to the time and rate, we
have ,839619 = *preſent worth of* 1*l for the time and rate.*
Mult. by 600 = *debt, or principal.*

503,771400= preſent worth of the debt.

2. What is the preſent worth of 312l. 10s. due 2 years hence, at $4\frac{1}{2}$ per cent. per annum, compound intereſt? *Anſ.* 286l. 3s. 3d. 2,97qrs.

3. What ready money will diſcharge a debt of 1000l. due 4 years hence, at 5l. per cent. per annum, compound intereſt? *Anſ.* 822l. 14s. 0d. 2,304 qrs.

ANNUITIES OR PENSIONS IN ARREARS, AT COMPOUND INTEREST.

CASE I.

When the annuity, or penſion, the time it continues and the rate per cent. are given, to find the amount.

RULE 1. Make 1 the 1ſt term of a Geometrical Progreſſion, and the amount of 1l. for 1 year at the given rate per cent. the ratio.

2. Carry the ſeries to ſo many terms as the number of years, and find its ſum.

3. Multiply the ſum, thus found, by the given annuity, and the product will be the amount ſought. Or, Multiply the amount of 1l. for 1 year into itſelf ſo many times as there are years, leſs by 1; then multiply this product by the annuity; and ſubtract the annuity therefrom; laſtly, divide the remainder by the ratio leſs 1, and the quotient will be the amount.

EXAMPLES.

EXAMPLES.

1. What will an annuity of 60l. per annum, payable yearly, amount to in 4 years, at 6l. per cent. ?

First Method.

$+1,06+1,06|^{2}+1,06|^{3}\times 60=$ £262l. 9s. $6\frac{1}{4}$d.

Second Method.

$$\frac{1,06\times 1,06\times 1,06\times 1,06\times 60-60}{1,06-1}=262,49$$

Or, BY TABLE III.

Multiply the tabular number under the rate, and oppoſite the time, by the annuity, and the product will be the amount.

2. What will an annuity, of 60l. per annum, amount to in 20 years, allowing 6l. per cent. compound intereſt ?

Under 6 per cent. and oppoſite 20 in table 3d, you will find tabular number=36,78559.

Multiply by 60=Annuity.

2207,13540=2207l. 2s. $8\frac{1}{4}$d.
(the *Anſ.*

CASE II.

When the amount, rate per cent. and time are given, to find the annuity, penſion, &c.

RULE. Multiply the whole amount by the amount of 1l. for 1 year, from which ſubtract the whole amount; divide the remainder by that power of the amount of 1l. for 1 year, ſignified by the number of years, made leſs by unity, and the quotient will be the anſwer.

EXAMPLES.

EXAMPLES.

1. What annuity, being forborne 4 years, will amount to 262,47696, at 6l. per cent. compound intereſt?

$$\frac{262,47696 \times 1,06 - 262,47696}{1,06 \times 1,06 \times 1,06 \times 1,06 - 1} = 60$$

Or, By TABLE III.

Divide the amount by the tabular number under the rate, and oppoſite to the time, and the quotient will be the annuity.

2. What annuity being forborne 20 years, will amount to £2207,1354, at 6l. per cent. compound intereſt?

Tabular amount=36,78559)2207,13540(60 *Anſ.*
2207,13540

CASE III.

When the annuity, amount and ratio are given, to find the time.

RULE. Multiply the amount by the ratio, to this product add the annuity, and from the ſum ſubtract the amount; this remainder being divided by the annuity, the quotient will be that power of the ratio ſignified by the time, which being divided by the amount of 1l. for 1 year and this quotient by the ſame, till nothing remain, the number of thoſe diviſions will be equal to the time. Or, look for this number under the given rate in Table I. and in a line with it you will ſee the time.

EXAMPLE.

In what time will 60l. per annum, payable yearly, amount to 262, 47696 allowing 6l. per cent. compound intereſt for the forbearance of payment?

In

In Table I. under the given rate, you will find 1,262476, and in a line under years, you will find 4.

PRESENT WORTH OF ANNUITIES, &c. AT COMPOUND INTEREST.

CASE I.

When the annuity, &c. rate and time are given, to find the preſent worth.

RULE* 1. Divide the annuity by the ratio, or the amount of 1l. for 1 year, and the quotient will be the preſent worth of 1 year's annuity.

2. Divide the annuity by the ſquare of the ratio, and the quotient will be the preſent worth for two years.

3. In like manner, find the preſent worth of each year by itſelf, and the ſum of all theſe will be the preſent value of the annuity ſought.

Or, Divide the annuity &c. by that power of the ratio ſignified by the number of years, and ſubtract the quotient from the annuity: This remainder being divided by the ratio leſs 1, the quotient will be the preſent worth.

EXAMPLES.

1. †What ready money will purchaſe an annuity of

* The amount of an annuity may alſo be found for years and parts of a year, thus:

1. Find the amount for the whole years, as before.

2. Find the intereſt of that amount for the given parts of a year.

3. Add this intereſt to the former account, and it will give the whole amount required.

The preſent worth of an annuity for years and parts of a year, may be found thus:

1. Find the preſent worth for the whole years as before.

2. Find the preſent worth of this preſent worth, diſcounting for the given parts of a year, and it will be the whole preſent worth required.

† Queſtions in this caſe may alſo be anſwered by firſt finding the amount of the given annuity by Caſe 1, of annuities in arrears, page 308, and then the preſent worth or principal, by Caſe 2, of Compound Intereſt, 305.

of 60l. to continue 4 years, at 6l. per cent. compound intereſt?

$$\overline{60}\,|^{4}{=}47{,}525 \quad 60{-}47525{=}12{,}475$$

$$\text{And}\ \frac{12{,}475}{{,}06}{=}207{,}916$$

By TABLE III.

Under 6l per cent. and oppoſite 4, we find
4,37461=Amount of 1l. annuity for 4 years.
Multiply by 60=Annuity.

262,47660=Amount of 60l. for 4 years.
Then oppoſite 4 years and under 6l. per cent. in Table II. we have ,792093 and ,79209;X262,7466=
(208,1197+
Or, oppoſite 4 years, and under 6l. per cent. in Table I. we have 1,26247=the amount of 1l. for 4 years:
Then, 262,7466÷1,26247=208,0219=208l. 2s. 5d. the anſwer.

By TABLE IV.

Multiply the tabular number, under the rate, and oppoſite the time, into the annuity, and the product will be the preſent worth.

Thus, in Example 1ſt. What ready money will purchaſe 60l. annuity, to continue 4 years, at 6l per cent compound intereſt?
Under 6l per cent. and even with 4 years,
We have 3,4651=preſent worth of 1l. for 4 years.
Mult. by 60=annuity.

Anſ.=207,9060=207l. 18s. 1¼d.

CASE

CASE II.

When the present worth, time and rate are given, to find the annuity, rent, &c.

RULE 1.—From that power of the ratio, denoted by the number of years plus 1, subtract that power of it, denoted by the number of years.

2. Divide the remainder by that power of the ratio, signified by the time made less by unity.

3. Multiply the present worth into this quotient, and the product will be the annuity, pension, rent, &c.

Or, 1. Multiply that power of the ratio, denoted by the number of years, plus 1, by the present worth.

2. Multiply that power of the ratio, denoted by the time, by the present worth, and subtract this product from the former.

3. Divide the remainder by that power of the ratio, denoted by the time made less by unity, and the quotient will be the annuity.

EXAMPLE.

1. What annuity, to continue 4 years, will 207,9041. purchase, compound interest, at 6l per cent.?

First Method.

From 1,06×1,06×1,06×1,06×1,06 = 1,338225776
Subt 1,06×1,06×1,06×1,06 = 1,26247696

Divide by 1,06⁴—1 =,26247696),07574806176(,2885896
And ,2885898×207,9 =£60.

Second Method.

From 1,06×1,06×1,06×1,06×1,06×207,9 = 278,217097573
Take 1,06×1,06×1,06×1,06×207,9 = 262,468959984

Divide by 1,06⁴—1 =,26247696)15,748137589
59,998 =£60

By TABLE V.

Multiply the tabular number, correſponding with the rate and time, by the purchaſe money, and the product will be the annuity.

Under 6l. per cent. and oppoſite 4 years, you will find ,28859=annuity which 1l. will purchaſe in 4 years; and ,28859X207,9=£60.

CASE III.

When the annuity, preſent worth, and ratio, are given, to find the time.

RULE.—Divide the annuity by the product of the preſent worth and ratio ſubtracted from the ſum of the preſent worth and annuity, and the quotient will be that power of the ratio, denoted by the number of years, which being divided by the ratio, and this quotient by the ſame, until nothing remain, the number of diviſions will ſhew the time:—Or, the above quotient being ſought in Table I, under the given rate, in a line with it you will ſee the time.

EXAMPLE.

For how long may an annuity of 60l. per annum be purchaſed for £207,906336762 at 6l. per cent. compound intereſt?

$$\frac{60}{207.906336762+60-207.906336762\times 1.06}=1,26247696$$

which being ſought in Table I, under the given rate is a line with it, is 4=4 years.

ANNUITIES, LEASES, &c. *taken in* REVERSION, *at* COMPOUND INTEREST.

CASE I.

When the annuity, time and ratio are given, to find the preſent worth of the annuity in reverſion.

RULE 1.—Divide the annuity by that power of the ratio, denoted by the time of its continuance.

2. Subtract

2. Subtract this quotient from the annuity: Divide he remainder by the ratio leſs 1, and the quotient will be the preſent worth, to commence immediately.

3. Divide this quotient by that power of the ratio denoted by the time of reverſion (or, time to come, before the annuity commences) and the quotient will be the preſent worth of the annuity in reverſion.

Or, 1. Multiply the annuity by that power of the ratio denoted by the time of its continuance minus unity, for a dividend.

2. Multiply that power of the ratio denoted by the time of its continuance, that power of it, denoted by the time of reverſion, and the ratio leſs 1 continually together for a diviſor, and the quotient ariſing from the diviſion of theſe two numbers will be the preſent worth of the annuity in reverſion.

Examples.

1. What is the preſent worth of 60l. payable yearly, for 4 years; but not to commence until 2 years hence at 6l. per cent.?

In table IVth, find the preſent value of 1l. at the given rate, both for the time in being and the time in reverſion added together, and ſubtract the preſent worth of the time in being from the other, multiply the remainder by the annuity, and the product will be the anſwer.

Preſent worth of time in being and reverſion = 4,91732
Preſent worth of the time in being = 1,8333

3,08402
60

£. 185,04120

$\frac{60}{1,26247696} = 47,5256$ Then, $\frac{60 - 47,5256}{1,06 - 1} = 207,906$

And $\frac{207,906}{1,1236} = 185,035876$

Or, $\frac{\overline{1,06}^{4} - 1 \times 60}{\overline{1,06}^{4} \times \overline{1,06}^{2} \times 1,06 - 1} = 185,036$

An

An annuity ſeveral times in reverſion, and rate, being given to find the ſeveral preſent values.

Find the preſent value of 1l. per Table IV, at the given rate and for the ſeveral given times, which being ſeverally multiplied by the annuity, the products will be the ſeveral preſent values of that annuity, for the ſeveral times given; ſubtract the ſeveral preſent values, the one from the other, and the ſeveral remainders will anſwer the queſtion.

2. A has a term of 6 years in an eſtate of 60l. per annum, B has a term of 14 years in the ſame eſtate, in reverſion, after the ſix years are expired; and C hath a farther term of 16 years, after the expiration of 20 years: I demand the preſent values of the ſeveral terms, at 6 per cent.?

	£. s. d
Preſ. val. of 1l. for 36 yrs. = 14,61722x60 =	877 0 7¼
Ditto of ditto for 20 = 11,46992x60 =	688 3 10¾
Ditto of ditto for 6 = 4,91732x60 =	295 0 9¼ = *A's term.*

Therefore, 877 0 7¼ — 688 3 10¾ = £188 16 9 = *C's term, and* 688 3 10¾ — 295 0 9¼ = £393 3 1½ = *B's term.*

3. For a leaſe of certain profits for 7 years, A offers to pay 300l. gratuity, and 300l. per annum; B offers 800l. gratuity, and 250l. per annum; C bids 1300l. gratuity and 200l. per annum, and D bids 2500l. for the whole purchaſe, without any yearly rent: Which is the beſt offer, computing at 6 per cent.?

	£
By Table IV, the preſent worth of 300l. per annum for 7 years, at 6 per cent. is	1674,714
To which add	300
Value of A's offer =	1974,714
Preſent worth of 250l. per annum for 7 years =	1395,595
To which add	800
Value of B's offer =	2195,595

Preſent

Preſent worth of 200l. per ann. for 7 years = 1116,476
To which add 1300

Value of C's offer = 2416,476

D's offer = 2500

Hence it appears that D's offer is beſt.

The above queſtions may be anſwered by the 4th and 2d Tables. Take queſtion 1ſt for example.

1. Multiply the tabular number in Table IV. correſponding to the rate and the time of continuance, into the annuity, and the product will be the preſent worth, to commence immediately.

2. Multiply this preſent worth by the tabular number in Table II, correſponding to the rate and the time of reverſion, and the product will be the preſent worth of the annuity in the reverſion.

In table 4th we have 3,4651
Multiply by 60 = Annuity.

207,9060

In Table 2d we have ,889996 and 207,906 × 889996
(= 185,0355 + Preſent worth of the reverſion.

CASE II.

When the preſent worth of the reverſion, rate and time are given, to find the annuity.

Rule 1.—Multiply that power of the ratio ſignified by the time of reverſion, by the preſent worth, and the product will be the amount of the preſent worth for the time before the annuity commences.

2. Multiply that power of the ratio ſignified by the time of continuance plus 1 by the laſt product.

3. Multiply that power of the ratio ſignified by the time by the aforeſaid product, and this laſt product, di-

vided by that power of the ratio denoted by the time, minus unity will give the annuity.

Or, Divide the continual product of the present worth, that power of the ratio denoted by the time of continuance, that power of it denoted by the time of reversion, and the ratio minus 1, by that power of the ratio denoted by the time of continuance minus 1, and the quotient will be the annuity.

EXAMPLES.

1. What annuity, to be entered upon 2 years hence, and then to continue 4 years, may be purchased for £185,035876 at 6l. per cent.?

Method 1.—185,036X1,1236 = 207,906

Then $\frac{207,906X1,33822-207,906X1,26247}{1,26247-1} = £60$ (Anſ.

Or, by Table IV. Divide the present worth of the reversion by the difference between the present worth of 1l. for the time both in being and reversion, and the time in being, and the quotient will be the annuity.

Meth. 2. $\frac{185,036X1,26247X1,1236X1,06-1}{1,26247-1} = 60.$

2. The present worth of a lease of a house is 431l. 15s. 7d. 2,78 9qrs. taken in reversion for 20 years, but not to commence until the end of 8 years, allowing 6l. per cent. to the purchaser; What is the yearly rent?

Anſ. £60.

TABLE

TABLE FIRST.

Shewing the amount of 1*l. from* 1 *year to forty years.*

yrs	5 per cent.	6 per cent.	yrs	5 per cent.	6 per cent.
1	1,0500000	1,0600000	21	2,7859625	3,3995636
2	1,1025000	1,1236000	22	2,9252607	3,6035374
3	1,1576250	1,1910160	23	3,0715237	3,8197496
4	1,2155062	1,2624769	24	3,2250999	4,0489346
5	1,2762815	1,3382256	25	3,3863549	4,2918707
6	1,3400956	1,4185191	26	3,5556716	4,7493829
7	1,4071004	1,5036302	27	3,7334563	4,8223459
8	1,4774554	1,5938480	28	3,9201291	5,1116867
9	1,5513282	1,6894789	29	4,1161356	5,4183879
10	1,6288946	1,7908476	30	4,3219423	5,7434912
11	1,7103293	1,8982985	31	4,5380394	6,0881007
12	1,7958563	2,0121964	32	4,7649414	6,4533867
13	1,8856491	2,1329282	33	5,0031885	6,8405899
14	1,9799316	2,2609039	34	5,2533479	7,2510253
15	2,0789281	2,3965581	35	5,5160152	7,6860868
16	2,1828745	2,5472719	36	5,7918101	8,147252
17	2,2920183	2,6927727	37	6,0814069	8,6860871
18	2,4066192	2,8543391	38	6,3854772	9,1542523
19	2,5269502	3,0255995	39	6,7047511	9,7035074
20	2,6532977	3,2071355	40	7,0399887	10,2857178

TABLE

TABLE SECOND.

Shewing the present Value of 1l. due at the end of any number of Years, from 1 to 40.

years.	5pr.cent	6pr.cent.	years.	5pr.cent.	6pr cent.
1	,952381	,943396	21	,358942	,294555
2	,90703	,889996	22	,34185	,277505
3	,863838	,839619	23	,325571	,261797
4	,822702	,792093	24	,310068	,246978
5	,783526	,747258	25	,30503	,232998
6	,746215	,70496	26	,28124	,21981
7	,710681	,665057	27	,267848	,207368
8	,676839	,627412	28	,255094	,19563
9	,644609	,594898	29	,242946	,184556
10	,613913	,558394	30	,231377	,17411
11	,584679	,562787	31	,220359	,164255
12	,556837	,496969	32	,209866	,154957
13	,530321	,468839	33	,199872	,146186
14	,505068	,442301	34	,190355	,137912
15	,481017	,417265	35	,18129	,130105
16	,458311	,393047	36	,172057	,122741
17	,436297	,371364	37	,164436	,115793
18	,415521	,350343	38	,156605	,109182
19	,395734	,330513	39	,149148	,103055
20	,376889	,311804	40	,142046	,097222

TABLE THIRD.

Shewing the amount of 1l. annuity for any number of years, from 1 to 40.

yrs.	5 per cent.	6 per cent	yrs.	5 per cent.	6 per cent.
1	1,	1,	21	35,719252	39,992725
2	2,05	2,06	22	38,505214	43,392289
3	3,1525	3,1836	23	41,430475	46,995826
4	4,310125	4,374616	24	44,501999	50,815576
5	5,525631	5,637093	25	47,727099	54,86451
6	6,801913	6,975318	26	51,113454	59,156381
7	8,142008	8,393837	27	54,669126	63,705763
8	9,549109	9,897467	28	58,402583	68,528109
9	11,026564	11,491315	29	62,322712	73,639796
10	12,577892	13,180794	30	66,438847	79,058183
11	14,206787	14,971642	31	70,76079	84,801674
12	15,917126	16,86994	32	75,298829	90,889775
13	17,712983	18,882132	33	80,063771	97,343161
14	19,598632	21,015064	34	85,066959	104,183751
15	21,578563	23,275968	35	90,320307	111,434776
16	23,657492	25,672527	36	95,836323	119,120863
17	25,840366	28,212879	37	101,628139	127,268114
18	28,132385	30,905652	38	107,709546	135,904201
19	30,529004	33,759991	39	114,095025	145,058453
20	33,065954	36,78559	40	120,799774	154,761961

TABLE FOURTH.

Shewing the present worth of 1l. annuity, for any number of years from 1 to 40.

ys.	5 per cent.	6 per cent.	ys.	5 per cent.	6 per cent.
1	0,95238	0,94339	21	12,82115	11,76407
2	1,85 41	1,83339	22	13,163	12,04158
3	2,72325	2,67301	23	13,48807	12,30338
4	3,54595	3,4651	24	13,79864	12,55035
5	4,32948	4,21236	25	14,09394	12,78335
6	5,07569	4,91732	26	14,37518	13,00316
7	5,78637	5,58238	27	14,64303	13,21053
8	6,46321	6,20979	28	14,89813	13,40616
9	7,10782	6,80169	29	15,14107	13,59072
10	7,72173	7,36008	30	15,37245	13,76483
11	8,30641	7,88687	31	15,59281	13,92908
12	8,86325	8,38384	32	15,80268	14,08398
13	9,39357	8,85268	33	16,00255	14,22917
14	9,89864	9,29498	34	16,1929	14,36613
15	10,37966	9,71225	35	16,37419	14,49533
16	10,83777	10,10589	36	16,54685	14,61722
17	11,27407	10,47726	37	16,71129	14,73211
18	11,68958	10,8276	38	16,86789	14,84048
19	12,08532	11,15811	39	17,01704	14,9427
20	12,46221	11,46992	40	17,15909	15,03913

TABLE FIFTH.

The annuity which 1l. will purchase for any number of years to come, from 1 to 40.

yrs.	5 per cent	6 per cent.	yrs.	5 per cent	6 per cent.
1	1,05	1,06	21	,078	,085
2	,5378	,54544	22	,07597	,08303
3	,36721	,37411	23	,07414	,08128
4	,28201	,28859	24	,07247	,07968
5	,23097	,23739	25	,07095	,07823
6	,19702	,20336	26	,06956	,0769
7	,17282	,17913	27	,06829	,0757
8	,15473	,16103	28	,06712	,07459
9	,14069	,14702	29	,06604	,07358
10	,1295	,13587	30	,06505	,07272
11	,12039	,12679	31	,06413	,07179
12	,11282	,11927	32	,06328	,071
13	,10645	,11296	33	,06249	,07027
14	,10102	,10758	34	,06175	,06959
15	,09624	,10296	35	,06107	,06899
16	,09227	,09895	36	,06043	,06839
17	,0887	,09544	37	,05984	,06785
18	,08555	,09235	38	,05928	,06735
19	,08274	,08962	39	,05876	,06689
20	,08024	,08718	40	,05828	,06646

ALLIGATION

Is the method of mixing two or more ſimples of different qualities ſo that the compoſition may be of mean or middle quality: it conſiſts of two kinds, viz. Alligation Medial, and Alligation Alternate.

ALLIGATION

ALLIGATION MEDIAL.

Is when the quantities and prices of ſeveral things are given to find the mean price of the mixture compounded of thoſe things.

Rule.—As the ſum of the quantities, or the whole compoſition, is to their total value; ſo is any part of the compoſition to its mean price or value.

Examples.

1. A tobacconiſt would mix 60lb. of tobacco, at 6d. per lb. with 50lb. at 1s. 4olb. at 1s 6, and 30lb. at 2s. per lb.—What is 1lb. of this mixture worth?

lb.	s.	d.	£.	s.
60 at	0	6 is	1	10
50—	1	0—	2	10
40—	1	6—	3	0
30—	2	0—	3	0
Anſ of ſimples. 180 lb. =			£10	0

As 180 : 10 :: 1

1

—

10

20

—

180)200(1s.

180

20

12

180)240(1⅓d.

180

60

s. d.

Anſ. 1 1⅓ pr. lb.

2. A farmer would mix 20 buſhels of wheat at 6s. per buſhel; 16 buſhels of rye, at 4s. per buſhel; 12 buſhels of barley, at 3s. per buſhel, and 8 buſhels of oats, at 2s per buſhel: What is the value of 1 buſhel of this mixture?

Anſ 4s. 2½d.

3. A

3. A wine merchant mixes 12 gallons of wine, at 4s. 10d. per gallon, with 24 gallons, at 5s. 6d. and 16 gallons, at 6s. $3\frac{1}{4}$d. What is a gallon of this compoſition worth? *Anſ.* 5s. 7d.

4. A goldſmith melted together 8oz. of gold of 22 carats fine, 1lb. 8oz. of 21 carats fine, and 100z. of 18 carats fine: Pray what is the quality, or fineneſs of the compoſition?

$$\frac{8\times22+20\times21+10\times18}{8+20+10}=20\frac{8}{19}$$ carats fine, *Anſ.*

5. A refiner melts 5lb. of gold, of 20 carats fine, with 8lb. of 18 carats fine: How much alloy muſt he put to it, to make it 22 carats fine?

$$22-5\times20+8\times18\div5+8=3\frac{3}{13}$$

Anſ. It is not fine enough, by $3\frac{3}{13}$ carats ſo that no alloy muſt be added, but more gold.

ALLIGATION ALTERNATE*

Is the method of finding what quantity of each of the ingredients, whoſe rates are given, will compoſe a mixture of a given rate; ſo that it is the reverſe of Alligation Medial and may be proved by it.

CASE

* By connecting the leſs rate with the greater, and placing the difference between them and the mean rate alternately, or one after the other, in turn, the quantities reſulting are ſuch that there is preciſely as much gained by one quantity as is loſt by the other; and therefore the gain and loſs upon the whole are equal and exactly the propoſed rate

In like manner let the number of ſimples be what it may, and with how many ſoever each one is linked, ſince it is always a leſs with a greater than the mean price, there will be an equal balance of loſs and gain between every two, and conſequently an equal balance on the whole

It is obvious from the rule, that queſtions of this ſort admit of a great variety of anſwers; for having found one anſwer, we may find as many more as we pleaſe, by only multiplying or dividing each of the quantities found, by 2, 3, 4, &c.

If any one of the ſimples be of little or no value with reſpect to the reſt, its rate is ſuppoſed to be nothing, as water *mixed with wine*, and alloy with gold and ſilver.

CASE I.

The whole work of this caſe conſiſts in linking the extremes truly together, and taking the differences between them and the mean price, which differences are the quantities ſought.

RULE 1. Place the ſeveral prices of the ſimples, being reduced to one denomination, in a column under each other, the leaſt uppermoſt, and ſo gradually downward as they increaſe; with a line of connection at the left hand, and the mean price at the left hand of all.

2. Connect with a continued line the price of each ſimple, or ingredient, which is leſs than that of the compound, with one or any number of thoſe, which are greater than the compound, and each greater rate or price with one, or any number, of the leſs.

3 Place the difference between the mean price (or mixture rate) and that of each of the ſimples oppoſite to the rates with which they are connected.

4. Then, if only one difference ſtand againſt any rate, it will be the quantity belonging to that rate; but if there be ſeveral, their ſum will be the quantity.

EXAMPLES.

1. A merchant has ſpices, ſome at 1s. 6d. per lb. ſome at 2s. ſome at 4s. and ſome at 5s per lb —How much of each ſort muſt he mix, that he may ſell the mixture at 3s. 4d. per lb. ?

d.		lb	s	d.
18		20	at 1	6
24		8	— 2	
48		16	— 4	
60		22	— 5	

Mean rate 40d. — per lb.

d		lb	s	d.
18		8	at 1	6
24		20	— 2	
48		22	— 4	
60		16	— 5	

40d. — per lb.

	d.		lb. s. d.	
40d	18	20+ 8	28 at 1 6	per lb.
	24	8	8—2	
	48	16+22	38—4	
	60	22	22—5	

	d.		lb. s. d.	
40d.	18	20	20 at 1 6	per lb.
	24	8+20	28—2	
	48	16	16—4	
	60	22+16	38—5	

	d.		lb. s d.	
40d.	18	20+ 8	28 at 1 6	per lb.
	24	8+20	28 —2	
	48	16+22	38—4	
	60	22+16	38—5	

Note. Theſe five anſwers ariſe from as many various ways of linking the rates of the ingredients together.

2. *A merchant has Canary wine, at 3s, per gallon; Sherry at 2s 1d. and Claret at 1s 5d. per gallon: How much of each ſort muſt he take to ſell it at 2s 4d. per gallon?

			s. d.	
Mean rate 28d.	36	3+11	14 at 3 0	per gall.
	25	8	8— 2 1	
	17	8	8— 1 5	

3. A goldſmith would mix gold of 19 carats fine, with ſome of 16, 18, 23 and 24 carats fine, ſo that the compound may be 21 carats fine; What quantity of each muſt he take?

21	16
	18
	19
	23
	24

4. It.

* Note, The ſecond queſtion admits but one way of linking, and ſo but of one anſwer; yet all numbers in the ſame proportion between themſelves, as the numbers which compoſe the anſwer, will likewiſe ſatisfy the condition of the queſtion

4. It is required to mix ſeveral ſorts of wine at 3s. 5s. and 7s. r gallon, with water, that the mixture may be worth 4s. per gallon: How much of each ſort muſt the mixture conſiſt of?

$$4\left\{\begin{matrix}0\\3\\5\\7\end{matrix}\right.\quad\left\{\begin{matrix}\textit{Anſ.}\ 3\text{ gal. water, 1 gal. wine, at 3s. 1}\\\text{ditto at 5s. and 4 ditto at 7s.}\end{matrix}\right.$$

CASE II.

When the rates of all the ingredients, the quantity of but one of them, and the mean rate of the whole mixture, are given to find the ſeveral quantities of the reſt in proportion to the quantity given.

RULE. Take the differences between each price and the mean rate and place them alternately, as in Caſe I. Then, as the difference ſtanding againſt that ſimple, whoſe quantity is given, is to that quantity; ſo is each of the other differences, ſeverally, to the ſeveral quantities required.

EXAMPLES.

1. A merchant has 40lb. of tea, at 6s. per lb. which he will mix with ſome at 5s. 8d. ſome at 5s. 2d. and ſome at 4s. 6d.—How much of each ſort muſt he take, to mix with the 40lb. that he may ſell the mixture at 5s. 5d. per lb.

			lb.	
d.	54	7+3	10	
65	62	3+7	10	
	68	3+11	14	(tity.
	72	11+3	14	ſtands againſt the given quan-
			lb.	lb.

As 14 : 40 :: { 10 : $28\frac{8}{14}$ at 4s. 6d. / 10 : $28\frac{8}{14}$ — 5s. 2d. / 14 : 40 — 5s. 8d. } per lb.

2. How

2. How much gold of 16, 20 and 24 carats fine, and how much alloy, muſt be mixed with 100z. of 18 carats fine, that the compoſition may be 22 carats fine?

Anſ. 100z. of 16 carats fine, 10 of 20, 170 of 24, and 10 of alloy.

ALTERNATION TOTAL.

CASE III.

When the rates of the ſeveral ingredients, the quantity to be compounded, and the mean rate of the whole mixture are given to find how much of each ſort will make up the quantity.

RULE. Place the differences between the mean rate, and the ſeveral prices alternately, as in Caſe 1ſt. Then, As the ſum of the quantities, or differences thus determined, is to the given quantity or whole compoſition; ſo is the difference of each rate, to the required quantity of each rate.

EXAMPLES.

1. Suppoſe I have 4 ſorts of currants, at 8d. 12d. 18d. and 22d. per lb.—the worſt would not ſell and the beſt were too dear; I therefore concluded to mix 120lb. and ſo much of each ſort, as to ſell them at 16d. per lb. —How much of each ſort muſt I take?

d.	lb.		lb.	lb.	
8	6		6 : 36 at 8d.		lb.
12	2	lb. lb.	2 : 12—12d.		
18	4	As 20 : 120 ::	4 : 24—18d.		
22	8		8 : 48—22d.		pr.
Sum=20			120		

2. A goldſmith has ſeveral ſorts of gold, viz. of 19, 17, 20 and 22 carats fine, and would melt together, of all theſe ſorts, ſo much as may make a maſs of

4oz. 18 carats fine; how much of each ſort is required?

Anſ. 16oz. 15 carats fine, 4oz. 17, 8oz. 20, and 12oz. of 22 carats fine.

3. How many gallons of water, of no value, muſt be mixed with wine at 4s per gallon, ſo as to fill a veſſel of 80 gallons, that may be afforded at 2s. 9d. per gallon.

Gal.

$$33\left\{\begin{matrix}0\\48\end{matrix}\right)\begin{matrix}15\\33\end{matrix}$$ Gal. Gal. Gal.

Sum 48 As 48 : 80 :: $\left\{\begin{matrix}15 : 25 \text{ of water}\\33 : 55 \text{ of wine}\end{matrix}\right\}$ *Anſ.*

CASE IV.

When more than one of the ſimples are limited.

Rule. Find by Alligation Medial, what will be the rate of a mixture made of the given quantities of the limited ſimples only; then, conſider this as the rate of a limited ſimple, whoſe quantity is the ſum of the firſt given limited ſimples, from which and the rates of the unlimited ſimples, by Caſe 2d. calculate the quantity.

Example.

How much wine at 4s. 6d. and at 5s. per gallon, muſt be mixed with 6 gallons at 4s. and 6 gallons at 3s. per gallon, that the mixture may be worth 4s. 4d. per gallon?

Gal. s. Gal.

Limited ſimples $\left\{\begin{matrix}6 \text{ gallons at } 4s. = 24\\6 \text{ gallons at } 3s. = 18\end{matrix}\right\}$ As 12 : 42 :: 1 : 3/6 (per gal.

12 42

Now having found the rate of the limited ſimples, the queſtion may ſtand thus: How much wine at 4s. 6d. and 5s. per gallon, muſt be mixed with 12 gallons at 4s. 6d. per gallon, that the mixture may be worth 4s. 3d. per gallon?

$$52\left\{\begin{matrix}42\\54\\60\end{matrix}\right)\begin{matrix}2+8\\10\\10\end{matrix}\Bigg|\begin{matrix}10\\10\\10\end{matrix}$$

As $10:\left\{\begin{matrix}10\\10\end{matrix}\right\}::12:\left\{\begin{matrix}12\text{ gallons at }4/6\\12\text{ gallons at }5s.\end{matrix}\right\}$ per gallon *Anſ.*

POSITION.

Poſition is a rule, which by falſe, or ſuppoſed numbers, taken at pleaſure, diſcovers the true ones required. It is divided into two parts; Single and Double.

SINGLE POSITION.

Single Poſition teaches to reſolve thoſe queſtions, whoſe reſults are proportional to their ſuppoſitions; ſuch as thoſe which require the multiplication or diviſion of the number ſought by any propoſed number; or when it is to be increaſed or diminiſhed by itſelf a certain propoſed number of times.

Rule 1. Take any number and perform the ſame operations with it, as are deſcribed to be performed in the queſtion.

2. Then ſay; as the ſum of the errors is to the given ſum; ſo is the ſuppoſed number to the true one required.

Proof.—Add the ſeveral parts of the ſum together and if it agrees with the ſum it is right.

Examples.

1. A ſchoolmaſter being aſked how many ſcholars he had, ſaid if I had as many more as I now have, three quarters as many, half as many, one fourth and one eighth as many, I ſhould then have 435; of what number did his ſchool conſiſt?

Suppoſe

Suppoſe he had 80 — As 290 : 435 :: 80

As many =	80	80	
$\frac{1}{2}$ as many =	60	———	120
$\frac{1}{3}$ as many =	40	29|0)3480|0(120 *Anſ.*	120
$\frac{1}{4}$ as many =	20	29	90
$\frac{1}{8}$ as many =	10	———	60
	———	58	30
	290	58	15
		———	———
		0	Proof 435

2. A perſon lent his friend a ſum of money unknown, to receive intereſt for the ſame at 6l. per cent. per annum, ſimple intereſt, and at the end of 12 years, received for principal and intereſt 860l.; what was the ſum lent? *Anſ.* 500l.

3. A, B and C joined their ſtocks, and gained 350l.; of which A took up a certain ſum; B took up four times ſo much as A, and C eight times ſo much as B; what ſhare of the gain had each?

	£.	s.	d.	qrs.	
Anſ.	9	9	2	$1\frac{3}{37}$	A's ſhare.
	37	16	9	$0\frac{12}{37}$	B's ditto.
	302	14	0	$2\frac{8}{37}$	C's ditto.

4. A, B, C and D ſpent 35s. at a reckoning, and being a little dipped, they agreed that A ſhould pay $\frac{2}{5}$, B $\frac{1}{2}$, C $\frac{1}{5}$, and D $\frac{1}{4}$; what did each pay in the above proportion?

		s.	d.
Anſ.	A,	13	4
	B,	10	
	C,	6	8
	D,	5	

5. A certain ſum of money is to be divided between 5 men in ſuch a manner as that A ſhall have $\frac{1}{4}$, B $\frac{1}{3}$, C $\frac{1}{10}$, D $\frac{1}{20}$, and E the remainder, which is 40l.; what is the ſum?

Suppoſe £200 then $\frac{1}{4} + \frac{1}{3} + \frac{1}{10} + \frac{1}{20} = 120$.

200—120=80, As, 80 : 40 :: 200 : 100, *Anſ.*

6. A.

6. A perſon after ſpending $\frac{1}{3}$ and $\frac{1}{5}$ of his money, had 26$\frac{2}{3}$l. left; what had he at firſt?

Anſ. £160.

7. A and B talking of their ages, B ſaid his age was once and a half the age of A; C ſaid his was twice and one tenth the age of both, and that the ſum of their ages was 93; what was the age of each?

Anſ. A's 12, B's 18 and C's 63 years.

8. A veſſel has 3 cocks, A, B and C; A can fill it in half an hour, B in $\frac{1}{4}$ of an hour, and C in $\frac{1}{3}$ of an hour; in what time will they all fill it together?

Anſ. $\frac{1}{9}$ hour.

9. A perſon having about him a certain number of dollars, ſaid that $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$ of them would make 57; Pray how many had he? Anſ. 60.

10. A gentleman bought a chaiſe, horſe and harneſs for 100l.; the horſe coſt $\frac{1}{4}$ more than the harneſs, and the chaiſe $\frac{1}{3}$ more than the horſe; what was the price of each?

Anſ. Har. £25$\frac{2}{47}$, horſe £31$\frac{4}{47}$, chaiſe £42$\frac{36}{47}$.

11. A and B, having found a purſe of money, diſputed who ſhould have it; A ſaid the $\frac{1}{7}$ $\frac{1}{10}$ and $\frac{1}{26}$ of it amounted to 35l. and if B could tell how much was in it he ſhould have the whole, otherwiſe he ſhould have nothing: how much did the purſe contain?

Anſ. 100l.

12. A gentleman divided his fortune among his ſons; to A he gave 9l. as often as to B 5l.; and to C but 3l. as often as to B 7l. yet C's portion came to 1050$\frac{4}{5}$; what was the whole eſtate?

Anſ. £9716$\frac{2}{35}$.

13. Seven eighths of a certain number exceeds four fifths by 6; what is that number?

Anſ. 80.

14. What number is that, which being increaſed by $\frac{2}{3}$, $\frac{3}{8}$ and $\frac{5}{6}$ of itſelf, the ſum will be 234$\frac{1}{4}$?

Anſ. 90.

DOUBLE

DOUBLE POSITION.

Double Position teaches to resolve questions by making two suppositions of false numbers

Those questions, in which the results are not proportional to their positions, belong to this rule; such are those in which the number sought is increased or diminished by some given number which is no known part of the number required.

Rule* 1.—Take any two convenient numbers and proceed with each according to the conditions of the question

2. Place the result or errors against their positions or supposed

Pos. Err.
numbers thus, 30 12 and if the error be too great
20 6
mark it with +; and if too small with —.

3. Multiply them crosswise; that is, the first position by the last error, and the last position by the first error.

4. If the errors be alike; that is, both too small, or both too great, divide the difference of the products by the difference of the errors, and the quotient will be the answer.

5. If the errors be unlike; that is, one too small, and the other too great, divide the sum of the products by the sum of the errors, and the quotient will be the answer.

Note, When the errors are the same in quantity, and unlike in quality, half the sum of the suppositions is the number sought.

Examples.

* The rule is founded on this supposition, that the first error is to the second, as the difference between the true and first supposed number is to the difference between the true and second supposed number; when that is not the case, the exact answer to the question cannot be found by this rule.

Examples.

1. A lady purchaſed damaſk for a gown, at 8s. per yard, and lining for it at 3s. per yard; the gown and lining contained 15 yards, and the price of the whole was 3l. 10s.—How many yards were there of each?

Suppoſe 6 yards damaſk, value 48s.
Then ſhe muſt have 9 yards of lining, value 27s.

Sum of their values=75s.
So that the firſt error is 5 too much, or + 5
Again, ſuppoſe ſhe had 4 yards of damaſk, value 32s.
Then ſhe muſt have 11 yards of lining, value 33s.

Sum of their values=65s.
So that the ſecond error is 5 too little, or — 5s.

6 5+
X
4 5—
— —
20 30
20
——
Sum of errors
=5 + 5 = 10)50
—

5 yds. at 8s = £2 0 0
10 yds. at 3s = 1 10 0
——
£3 10 0
(Proof.

Anſ. 5 yards damaſk, and 15—5=10 yds. (lining.

Or, 6+4÷2=5 as before.

2. A and B have the ſame income: A ſaves ⅓ of his, but B, by ſpending 30l. per annum more than A, at the end of 8 years finds himſelf 40l. in debt; what is their income, and what does each ſpend per annum?

Suppoſe { 80 120+ / × / 160 40+ } *Anſ.* Their income is 200l. (per annum. Alſo, A ſpends 175l. and B (205l per annum.

Then 80—10=70, A's expenſe per annum: and

70

70+30 = 100, B's expenſe per annum.——Then 100X8—80X8=160, which ſhould have been 40; therefore 160—40=120 more than it ſhould be, for the firſt error. In like manner proceed for the ſecond error.

3. A and B laid out equal ſums of money in trade: A gained a ſum equal to $\frac{1}{4}$ of his ſtock, and B loſt 225l.; then A's money was double that of B; what did each lay out?

Suppoſe $\begin{cases} 300 & 225+ \\ & \times \\ 900 & 225- \end{cases}$ *Anſ.* 600l.

4. A labourer was hired for 60 days upon this condition, that for every day he wrought, he ſhould receive 3s. 4d. and for every day he was idle, ſhould forfeit 1s. 8d.—at the expiration of the time he received 3l. 15s.; how many days did he work, and how many was he idle?

Suppoſe he worked $\begin{cases} 20 & 900 \\ & \times \\ 40 & 300+ \end{cases}$

Anſ. He was employed 35 days and was idle 25.

5. A gentleman has two horſes of conſiderable value, and a carriage worth 100l. Now, if the firſt horſe be harneſſed in it, he and the carriage together will be triple the value of the ſecond; but if the ſecond be put in, they will be 7 times the value of the firſt? what is the value of each horſe?

Suppoſe $\begin{cases} 32 & 80- \\ & \times \\ 44 & 160- \end{cases}$

Anſ. One 20l. and the other 40l.

6. There is a fiſh, whoſe head is 10 feet long; his tail is as long as his head and half the length of his body, and his body as long as the head and tail? what is the whole length of the fiſh?

Head

Head=10
First, suppose the body 20 10—Tail=30
X Body=40
2d, suppose it 30 5— —
Anſ. 80 feet.

7. What number is that, which being increaſed by its $\frac{1}{2}$, its $\frac{1}{4}$ and 5 more, will be doubled?

Suppoſe $\left\{\begin{matrix} 8 & 3+ \\ X & \\ 16 & 1+ \end{matrix}\right.$ Anſ. 20.

8. A farmer having driven his cattle to market, received for them all, 80l. being paid at the rate of 6l. per ox, 4l. per cow, and 1l. 10s. per calf; there were as many oxen as cows, and 4 times as many calves as cows: How many were there of each ſort?

Suppoſe cows 6 16+
X
Suppoſe 12 132+
Anſ. 5 oxen, 5 cows, and 20 calves.

9. A, B and C built a ſhip which coſt them £1000— of which A paid a certain ſum—B paid 100l. more than A, and C 100l. more than both; having finiſhed her, they fixed her for ſea, with a cargo worth twice the value of the ſhip: The outfits and charges of the voyage amounted to $\frac{1}{5}$ of the ſhip; upon the return of which, they found their clear gain to be $\frac{2}{3}$ of $\frac{3}{7}$ of the veſſel, cargo and expenſes: Pleaſe to inform me what the ſhip coſt them ſeverally; what ſhare each had in her, and what, upon the final adjuſtment of their accompts, they had ſeverally gained?

Suppoſe it coſt A £100 300—
X
Suppoſe 200 100+

A owned $\frac{7}{40}$ of the ſhip, which coſt him 175l. and his ſhare of the gain was 218l. 15s.—B owned $\frac{11}{40}$, which coſt 275l., and his gain was 343l. 15s.—C owned $\frac{11}{80}$, which coſt 550l. and his gain was 687l. 10s.

PERMUTATIONS AND COMBINATIONS.

The Permutation of Quantities is the ſhewing how many different ways any given number of things may be changed.

This is alſo called variation, alternation, or changes; and the only thing to be regarded here is the order they ſtand in; for no two parcels are to have all their quantities placed in the ſame ſituation.

The Combination of Quantities is the ſhewing how often a leſs number of things can be taken out of a greater, and combined together, without conſidering their places, or the order they ſtand in.

This is ſometimes called election or choice; and here every parcel muſt be different from all the reſt, and no two are to have preciſely the ſame quantities or things.

The Compoſition of Quantities is the taking of a given number of quantities out of as many equal rows of different quantities, one out of every row, and combining them together.

Here no regard is had to their places; and it differs from combination only, as that admits of but one row of things.

Problem I.

To find the number of permutations, or changes, that can be made of any given number of things, all different from each other.

Rule.* Multiply all the terms of the natural ſeries of numbers, from 1 up to the given number, continually together and the laſt product will be the anſwer required.

Examples.

* Any two things a and b are capable of two variations only; as ab, ba; whoſe number is expreſſed by 1×2.

If there be three things, a, b and c, then any two of them, leaving out the third, will have 1×2 variations; and conſequently when the third is taken in, there will be $1\times2\times3$ variations; and ſo on, as far as you pleaſe.

EXAMPLES.

1. Chriſt Church, in Boſton, has 8 bells; how many changes may be rung on them?

$1\times2\times3\times4\times5\times6\times7\times8=40320$ the *Anſ.*

2. Nine gentlemen met at an inn, and were ſo pleaſed with their hoſt, and with each other, that in a frolick they agreed to tarry ſo long as they, together with their hoſt, could ſit every day in a different poſition at dinner; pray how long, had they kept their agreement, would their frolick have laſted? *Anſ.* $9941\frac{335}{365}$ years.

3. How many changes or variations will the alphabet admit of? *Anſ.* 620448401733239439360000.

PROBLEM 2.

Any number of different things being given—to find how many changes can be made out of them, by taking any given number of quantities at a time.

RULE. Take a ſeries of numbers, beginning at the number of things given, and decreaſing by one, to the number of quantities to be taken at a time; the product of all the terms will be the anſwer required.

EXAMPLES.

1. How many changes may be rung with 4 bells out of 8?

$8\times7\times6\times5(=4\text{ terms})=1680$ the *Anſ.*

2. How many words can be made with 6 letters of the alphabet, admitting a number of conſonants may make a word? *Anſ.* 96909120.

PROBLEM 3.

Any number of things being given—whereof there are ſeveral things of one ſort, ſeveral of another, &c. To find how many changes may be made out of them all.

RULE* 1. Take the ſeries $1\times2\times3\times4$, &c. up to the

* Any 2 quantities, *a*, *b*, both different, admit of two changes; but if the quantities are the ſame, or *ab* become *aa*, there will be one alteration, which may be expreſſed by $\frac{1\times2}{1\times2}=1$.

Any

the number of things given, and find the product of all the terms.

2. Take the series $1\times2\times3\times4$, &c. up to the number of the given things of the first sort, and the series, $1\times2\times3\times4$, &c. up to the number of the given things of the second sort, &c.

3. Divide the product of all the terms of the first series by the joint product of all the terms of the remaining ones and the quotient will be the answer required.

Examples.

1. How many variations may be made of the letters in the word Zaphnathpaaneah?

$1\times2\times3\times4\times5\times6\times7\times8\times9\times10\times11\times12\times13\times14\times15$ (= number of letters in the word) $=1307674368000$

$1\times2\times3\times4\times5$ (= number of a's) $=120$

1×2 (= number of p's) $=2$

1 (= number of t's) $=1$

$1\times2\times3$ (= number of h's) $=6$

1×2 (= number of n's) $=2$

$2\times6\times1\times2\times1\times20=2880)1307674368000(454053600$—the *Ans.*

2. How many different numbers can be made of the following figures, 122333444? *Ans.* 12600.

Problem 4.

To find the number of combinations of any given number of things, all different from one another, taking one given number at a time.

Rule* 1. Take the series 1, 2, 3, 4, &c. up to the

Any 3 quantities, *a*, *b*, *c*, all different from each other, admit of 6 variations; but if the quantities are all alike, or *abc* become *aaa* then the 6 variations will be reduced to 1, which may be expressed by $\frac{1\times2\times3}{1\times1\times3}=1$. Again if two quantities out of three are alike, or, *abc*, become *aac*; then the 6 variations will be reduced to these 3, *aac*, *caa*, *aca*, which may be expressed by $\frac{1\times2\times3}{1\times2}=3$, and so of any greater number.

* In any given number of quantities, the number of combinations increases gradually until you come about the mean numbers,

the number to be taken at a time, and find the product of all the terms.

2. Take a series of as many terms, decreasing by 1, from the given number, out of which the election is to be made, and find the product of all the terms.

3. Divide the last product by the former, and the quotient will be the number sought.

Examples.

1. How many combinations may be made of 7 letters out of 12 ?

1X2X3X4X5X6X7 (=the number to be taken at a time) = 5040

12X11X10X9X8X7X6 (=same number from 12) = 3991680

5040)3991680(792 the Anſ.

2. How many combinations can be made of 6 letters out of the 24 letters of the alphabet ? Anſ. 134596.

3. A general was aſked by his king, what reward he ſhould confer on him for his ſervices ; the general only required a penny for every file, of 10 men in a file, which he could make out of a company of 90 men : What did it amount to ? Anſ. £2383602284l 7s. $11\frac{65}{1124}$.

4. A farmer bargained with a gentleman for a dozen ſheep (at 2 dollars per head) which were to be picked out of 2 dozen ; but being long in chooſing them, the gentleman told him that if he would give him a penny for every different dozen which might be choſen out of the two dozen he ſhould have the whole, to which the farmer readily agreed : Pray what did they coſt him ?

Anſ. £11267 6s. 4d.

Problem

bers, and then gradually decreaſes. If the number of quantities be even, half the number of places will ſhew the greateſt number of combinations, that can be made of thoſe quantities ; but if odd, then thoſe two numbers, which are the middle, and whoſe ſum is equal to the given number of quantities, will ſhew the greateſt number of combinations.

Problem 5.

To find the compoſitions of any number, in an equal number of ſets, the things being all different.

Rule. Multiply the number of things in every ſet continually together, and the product will be the anſwer required.

Examples.

1. Suppoſe there are 5 companies, each conſiſting of 12 men: it is required to find how many ways 9 men may be choſen one out of each company?

$9\times9\times9\times9\times9=59049$ different ways.

2. How many chances are there in throwing 4 dice?

As a die has 6 ſides, multiply 6 into itſelf 3 times continually. $6\times6\times6\times6=1296$ chances, Anſ.

3. Suppoſe a man undertakes to throw an ace at one throw with 4 dice: what is the probability of his effecting it?

Firſt, $6\times6\times6\times6=1296$ different ways with and without the ace;

Then, if we exclude the ace ſide of the die, there will be five ſides left, and $5\times5\times5\times5=625$ ways without the ace; therefore there are $1296-625=671$ ways, wherein one or more of them may turn up an ace: and the probability that he will do it, as 671 to 625, Anſ.

THE USE OF LOGARITHMS.

1. In Multiplication.

Given two numbers, viz. 275 and 12,6 to find their product.

Rule. To the logarithm of 275, viz.	2,43933
Add the logarithm, of 12,6, viz.	1,10037
And their ſum is the logarithm of their product, viz.	3465=3,53970

2. In Division

Let it be required to find the quotient, which ariſes by dividing one number by another; ſuppoſe 1425 by 57.

From

From the logarithm of the dividend, viz. 1425 = 3,15381
Take the logarithm of the divisor, viz. 57 = 1,75587
And the remainder is the logarithm of the quotient, viz. 25 = 1,39794

3. In the Rule of Three.

Three numbers given to find a fourth, in direct proportion.

Rule. From the tables take the logarithms of each of the proposed numbers, then add the logarithms of the second and third together, and from the sum take the logarithm of the first and the remainder will be the logarithm of the fourth number.

Let the three proposed numbers be 18, 24 and 33, and the operation will stand thus:

1,38021 = the logarithm of 24, the 2d. term.
1,51851 = the logarithm of 33, the 3d. term.
2,89872 = the logarithm of their product.
—1,25527 = the logarithm of the 1st term 18.
1,64345 = the logarithm of the 4th term required, which, by the Table answers to the natural number 44, the 4th proportional to the three proposed numbers.

4. In Involution, or Raising Powers.

To find any power of any proposed number, or to involve any number to any proposed power, by logarithms.

Rule. Multiply the logarithm of the given root by the power, viz. by 2 for the square, by 3 for the cube, &c. and the product is the logarithm of the power sought.

Required to find the cube of 12?

1,07918 = the logarithm of 12.
× 3 = the third power, or cube.
3,23754 = 1728 the cube of 12.

5. In Evolution, or Extracting Roots.

To Extract any root of any proposed number.

Rule. Divide the logarithm of the proposed number by the index of the required root, viz. by 2 for the square, by 3 for the cube, &c. and the quotient will be the logarithm of the root required.

Required

Required to find the cube root of 1728?

3,23754=the logarithm of 1728, and 3,23754÷3=1,07918 is the logarithm of the cube root of 1728, viz. 12.

6. In Compound Interest.

To find the amount of any sum for any time, and at any rate at compound interest.

Rule. Multiply the logarithm of the ratio (i. e. the amount of 1l. for 1 year) by the number of years, and to the product add the logarithm of the principal; the sum will be the logarithm of the amount.

What will 45l. amount to forborne 12 years, at 6 per cent. per annum, compound interest?

Log. of 1,06, the ratio, is ,02533
Multiply by the time 12

,30396
Add Log. of 45, the principal 1,65321

The sum is 1,95717 which is the logarithm of 90,7=£90 14s. Anſ.

7. In Discount at Compound Interest.

To find the preſent worth of any ſum of money, due any time hence, at any rate, at compound intereſt.

Rule. From the logarithm of the ſum to be diſcounted, ſubtract the logarithm of the rate multiplied by the time; and the remainder is the logarithm of the preſent worth.

What preſent money will pay a debt of 90l. 14s. due 12 years hence, diſcounting at the rate of 6 per cent. per annum?

From the logarithm of 90l. 14=1,95717
Sub. product of the Log. of the ratio X by the time. } = ,30396

The remainder 1,65421 is the logarithm of 45l. Anſ.

N. *Ham.*

N Hamp. Maſſach. R. Iſland. Connecti-cut and Virginia.			*Federal Coin.*	*New York and North Carolina*			*N Jerſey, Pennſylvania Delaware and Maryland*			*S. Carolina and Georgia.*			*French Money.*	
£.	s.	d.	Dol. d. c.	£.	s.	d.	£.	s.	d.	£.	s.	d	Liver.	Sous
		1	0,01 7/18			1 1/3			1 1/4			7/9	Four.	1 1/2 1/4
		2	0,02 7/9			2 2/3			2 1/2		1	5/9		2 1/2
		3	0,04 1/6			4			3 3/4		2	3/9		4 3/9
		4	0,05 5/9			5 1/3			5		3	1/9		5 5/9
		5	0,06 8/9			6 2/3			6 1/4		3	8/9		7 7/9
		6	0,08 1/3			8			7 1/2		4	6/9		8 1/4
		7	0,09 2/3			9 1/3			8 3/4		5	4/9		10 5/9
		8	0,11 1/9		1	2/3			10		6	2/9		11 2/3
		9	0,12 1/2		1	0			11 1/4		7			13 1/3
		10.	0,13 8/9		1	1 1/3		1	0 1/2		7	7/9		14 7/18
		11	0,15 1/3		1	2 2/3		1	1 1/4		8	5/9		16 1/24
	1	0	0,16 2/3		1	4		1	3		9	3/9		17 1/2
	2	0	0,33 1/3		2	8		2	6		1	6/9	1	15
	3	0	0,50		4	0		3	9		2	4	2	12 1/2
	4	0	0,66 2/3		5	4		5	0		3	1/9	3	10
	5	0	0,83 1/3		6	8		6	3		3	10/9	4	7 1/2
	6	0	1,00		8	0		7	6		4	8	5	5
	7	0	1,16 2/3		9	4		8	9		5	4 3/9	6	2 1/2
	8	0	1,33 1/3		10	8		10	0		6	2 5/9	7	0
	9	0	1,50		12	0		11	3		7	0	7	17 1/2
	10	0	1,66 2/3		13	4		12	6		7	9 3/9	8	15
1	0	0	3,33 1/3	1	6	8	1	5	0		15	6 5/9	17	10
2	0	0	6,66 2/3	2	13	4	2	10	0	1	11	1 3/9	35	
3	0	0	10,00	4	0	0	3	15	0	2	6	8	52	10
4	0	0	13,33 1/3	5	6	8	5	0	0	3	2	2 6/9	70	
5	0	0	16,66 2/3	6	13	4	6	5	0	3	17	9 3/9	87	10
6	0	0	20.00	8	0	0	7	10	0	4	13	4	105	
7	0	0	23,33 1/3	9	6	8	8	15	0	5	8	10 5/9	122	10
8	0	0	26,66 2/3	10	13	4	0	0	0	6	4	5/9	140	
9	0	0	30,00	12	0	0	1	5	0	7	0	0	157	10
10	0	0	33,33 1/3	13	6	8	12	10	0	7	15	6 6/9	175	

Federal

Federal Money	N. Hampshire, Massachusetts, R. Island, Connecticut & Virginia.	New York and N. Carolina	N. Jersey Pennsylvania and Maryland	S. Carolina and Georgia.	French.
D. d. c.	£. s. d.	s. d.	£. s. d.	£. s. d.	Liver. Sous.
0,0 1	$\frac{1}{2}\frac{1}{3}$	$\frac{2}{2}\frac{4}{3}$	$\frac{9}{10}$	$\frac{1}{2}\frac{4}{3}$	Tour. $1\frac{1}{20}$
0,0 2	$1\frac{1}{23}$	$1\frac{2}{2}\frac{3}{3}$	$1\frac{8}{10}$	$1\frac{3}{23}$	$2\frac{1}{10}$
0,0 3	$2\frac{2}{23}$	$2\frac{2}{2}\frac{2}{3}$	$2\frac{7}{10}$	$2\frac{17}{23}$	$3\frac{3}{20}$
0,0 4	$3\frac{2}{23}$	$3\frac{2}{2}\frac{1}{3}$	$3\frac{6}{10}$	$2\frac{6}{23}$	$4\frac{1}{5}$
0,0 5	$3\frac{3}{23}$	$4\frac{4}{23}$	$4\frac{5}{10}$	$3\frac{4}{23}$	$5\frac{1}{4}$
0,0 6	$4\frac{3}{23}$	$5\frac{19}{23}$	$5\frac{4}{10}$	$3\frac{9}{23}$	$6\frac{3}{10}$
0,0 7	$5\frac{1}{23}$	$6\frac{18}{23}$	$6\frac{3}{10}$	$3\frac{23}{23}$	$7\frac{7}{20}$
0,0 8	$5\frac{19}{23}$	$7\frac{17}{23}$	$7\frac{2}{10}$	$4\frac{12}{23}$	$8\frac{3}{5}$
0,0 9	$6\frac{12}{23}$	$8\frac{16}{23}$	$8\frac{1}{10}$	$5\frac{1}{23}$	$9\frac{9}{20}$
0,1 0	$7\frac{1}{3}$	$9\frac{1}{3}$	9	$5\frac{3}{3}$	$10\frac{1}{2}$
0,2 0	$1\ 2\frac{2}{3}$	$1\ 7\frac{1}{3}$	1 6	$1\ 1\frac{1}{3}$	1 1
0,3 0	$1\ 9\frac{3}{3}$	$2\ 4\frac{2}{3}$	2 3	$1\ 4\frac{4}{3}$	$1\ 11\frac{1}{2}$
0,4 0	$2\ 4\frac{4}{3}$	$3\ 2\frac{2}{3}$	3 0	$2\ 10\frac{2}{3}$	2 2
0,5 0	3 0	4 0	3 9	2 4	$2\ 12\frac{1}{2}$
0,6 0	$3\ 7\frac{1}{3}$	$4\ 9\frac{1}{3}$	4 6	$2\ 9\frac{3}{3}$	3 3
0,7 0	$4\ 2\frac{2}{3}$	$5\ 7\frac{2}{3}$	5 3	$3\ 3\frac{1}{3}$	$3\ 13\frac{1}{2}$
0,8 0	$4\ 9\frac{3}{3}$	$6\ 4\frac{3}{3}$	6 0	$3\ 8\frac{4}{3}$	4 4
0,9 0	$5\ 4\frac{4}{3}$	$7\ 2\frac{4}{3}$	6 9	$4\ 2\frac{2}{3}$	$4\ 14\frac{1}{2}$
1,0 0	6 0	8 0	7 6	4 8	5 5
2,0 0	12 0	16 0	15 0	9 4	10 10
3,0 0	18 0	1 4 0	1 2 6	14 0	15 15
4,0 0	1 4 0	1 12 0	1 10 0	18 8	21 0
5,0 0	1 10 0	2 0 0	1 17 6	1 3 4	26 5
6,0 0	1 16 0	2 8 0	2 5 0	1 8 0	31 10
7,0 0	2 2 0	2 16 0	1 12 6	1 12 8	36 15
8,0 0	2 4 0	3 4 0	3 0 0	1 17 4	42 0
9,0 0	2 14 0	3 12 0	3 7 6	2 2 0	47 5
10,0 0	3 0 0	4 0 0	3 15 0	2 0 8	52 10
20,0 0	6 0 0	8 0 0	7 10 0	4 13 4	105 0
30,0 0	9 0 0	12 0 0	11 5 0	7 0 0	157 10
40,0 0	12 0 0	16 0 0	15 0 0	9 6 8	210 0
50,0 0	15 0 0	20 0 0	18 15 0	11 13 4	265 10

A TABLE, directing how to buy and sell by the Hundred

d.	£.	s.	d.	s.	d.	£.	s.	d.	s.	d.	£.	s.	d.
¼	0	2	4		8¼	3	17	0	1	4¼	7	11	8
½	0	4	8		8½	3	19	4	1	4½	7	14	0
¾	0	7	0		8¾	3	1	8	1	4¾	7	16	4
1	0	9	4		9	4	4	0	1	5	7	18	8
1¼	0	11	8		9¼	4	6	4	1	5¼	8	1	0
1½	0	14	0		9½	4	8	8	1	5½	8	3	4
1¾	0	16	4		9¾	4	11	0	1	5¾	8	5	8
2	0	18	8		10	4	13	4	1	6	8	8	0
2¼	1	1	0		10¼	4	15	8	1	6¼	8	10	4
2½	1	3	4		10½	4	18	0	1	6½	8	12	8
2¾	1	5	8		10¾	5	0	4	1	6¾	8	15	0
3	1	8	0		11	5	2	8	1	7	8	17	4
3¼	1	10	4		11¼	5	5	0	1	7¼	8	19	8
3½	1	12	8		11½	5	7	4	1	7½	9	2	0
3¾	1	15	0		11¾	5	9	8	1	7¾	9	4	4
4	1	17	4		12	5	12	0	1	8	9	6	8
4¼	1	19	8	1	0¼	5	14	4	1	8¼	9	9	0
4½	2	2	0	1	0½	5	16	8	1	8½	9	11	4
4¾	2	4	4	1	0¾	5	19	0	1	8¾	9	13	0
5	2	6	8	1	1	6	1	4	1	9	9	16	0
5¼	2	9	0	1	1¼	6	3	8	1	9¼	9	18	4
5½	2	11	4	1	1½	6	6	0	1	9½	10	0	8
5¾	2	13	8	1	1¾	6	8	4	1	9¾	10	3	0
6	2	16	0	1	2	6	10	8	1	10	10	5	4
6¼	2	18	4	1	2¼	6	13	0	1	10¼	10	7	
6½	3	0	8	1	2½	6	15	4	1	10½	10	10	0
6¾	3	3	0	1	2¾	6	17	8	1	10¾	10	12	4
7	3	5	4	1	3	7	0	0	1	11	10	14	8
7¼	3	7	8	1	3¼	7	2	4	1	11¼	10	17	0
7½	3	10	0	1	3½	7	4	8	1	11½	10	19	4
7¾	3	12	4	1	3¾	7	7	0	1	11¾	11	1	8
8	3	14	8	1	4	7	9	4	2	0	11	4	0

A TABLE

A TABLE for reducing Troy Weight to Avoirdupois.

Troy.	Avoirdupois.		
lb.	lb:	oz	grams.
4000	3091	6	13.68
000	2528	9	2.26
.000	1645	11	6,84
1000	822	13	1.42
900	740	9	2,28
800	658	4	9,14
700	576	0	0,
600	493	11	6,85
500	411	6	13.71
400	329	2	4,57
300	246	13	11 42
200	164	9	2.28
100	82	4	9.15
90	74	0	13,62
80	65	13	4.11
70	57	9	9,6
60	49	5	15,08
50	41	2	4,57
40	32	14	10 05
30	24	10	19.54
20	16	7	5,03
10	8	3	10.52
9	7	6	7,86
8	6	9	3.21
7	5	12	2.56
6	4	14	15.9
5	4	1	13.25
4	3	4	10 6
3	2	7	7.95
2	1	10	5.3
1	0	13	2.65
oz.		12	1.09
11		10	15.54
10		9	13.99
9		8	12,43
8		7	10,88
7		6	9.32
6		5	7,77
5		4	6,22
4		3	4 66
3		2	3,11
2		1	1,55
1			

Troy.	Avoir.
pwt.	drams.
19	16,67
18	15 79
17	14,92
16	14,04
15	13,16
14	12,29
13	11.41
12	10,53
11	8 65
10	9,78
9	7.9
8	7,02
7	6,14
6	5,27
5	4,39
4	3,51
3	2,63
2	1 75
1	0,88
gr.	
23	,84
22	,8
21	,77
20	,73
19	,69
18	,66
17	,62
16	,58
15	,55
14	,51
13	,47
12	,44
11	,4
10	,36
9	,33
8	,29
7	,26
6	,22
5	,18
4	,15
3	,11
2	,07
1	,04

A TABLE

A TABLE for reducing Avoirdupois Weight, to Troy Weight.

Avoir.	*Troy.*				*Av.*	*Troy.*			
lb.	lb.	*oz.*	*pwt.*	*gr.*	*oz.*	lb.	*oz.*	*pwt.*	*gr.*
6000	7291	8	0	0	15	1	1	13	10,5
5000	6076	4	13	8	14	1	0	15	5
4000	4861	1	6	16	13		11	16	23,5
3000	3645	10	0	0	12		10	18	18
2000	2430	6	13	8	11		10	0	12,5
1000	1215	3	6	16	10		9	2	7
900	1093	9	0	0	9		8	4	1,5
800	972	2	13	8	8		7	5	20
700	850	8	6	16	7		6	7	14,5
600	729	2	0	0	6		5	9	9
500	607	7	13	8	5		4	11	3,5
400	486	1	6	16	4		3	12	22
300	364	7	0	0	3		2	14	16,5
200	243	0	13	8	2		1	16	11
100	121	6	6	16	1			18	5,5
90	109	4	10	0	*dr.*				
80	97	2	13	8	15			17	2,1
70	85	0	16	16	14			15	22,76
60	72	11	0	0	13			14	19,42
50	60	9	3	8	12			13	15,08
40	48	7	6	16	11			12	12,74
30	36	5	10	0	10			11	9,4
20	24	3	13	8	9			10	6,06
10	12	1	16	16	8			6	2,72
9	10	11	5	0	6			8	23,39
8	9	8	13	8	7			7	20,04
7	8	6	1	16	5			6	16,7
6	7	3	10	0	4			5	13,36
5	6	0	18	8	3			3	10,02
4	4	10	6	16	2			2	6,68
3	3	7	15	0	1			1	3,34
2	2	5	3	8	¾				20,51
1	1	2	11	16	½				12,67

APPENDIX.

CONGRESS have made foreign Gold and Silver Coins a legal tender for the payment of all debts and demands, at the feveral and refpective rates following, viz. The Gold Coins of Great Britain and Portugal, of their prefent ſtandard at the rate of 100 cents for every 27 grains of the actual weight thereof—Thoſe of France and Spain 27$\frac{2}{3}$ grains of the actual weight thereof—Spaniſh Milled Dollars, weighing 17 pwt. 7 grs. equal to 100 cents and in proportion for the parts of a dollar—Crowns of France, weighing 18 pwt. 17 grs. equal to 110 cents and in proportion for the parts of a Crown. They have enacted, That every cent ſhall contain 208 grains of copper, and every half cent 104 grains; agreeably to which, the following Tables are calculated.

WEIGHTS *of ſeveral pieces of Engliſh, Portugueſe, and French Gold Coins, according to a late Act of Congreſs, paſſed November*, 1792.

	Pwt.	*Gr.*	*Dolls.*	*Cents.*	*Mills.*
Double Johannes	18		16	0	0
Single ditto	9		8		
Engliſh Guinea	5	6	4	66$\frac{2}{3}$	
Half ditto	2	15	2	33$\frac{1}{3}$	
French Guinea	5	6	4	59	8
Half ditto	2	15	2	29	9
4 Piſtoles	16	12	14	45	2
2 Piſtoles	8	6	7	22	6
1 Piſtole	4	3	3	61	3
Moidore	6	22	6	14	8

Weight of English and Portuguese Gold, in Dollars, Cents and Mills, agreeably to an Act of Congress, passed in the Session of November, 1792.

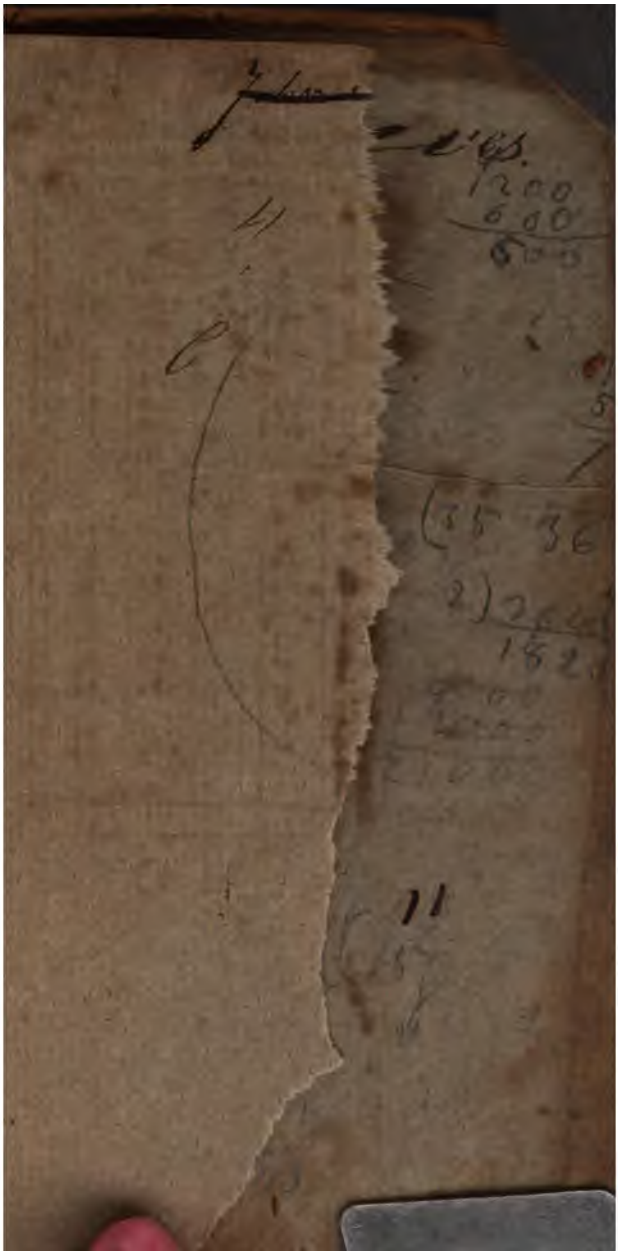
Grs.	Cents.	Mills.	Pwts.	Dolls.	Cents.	Mills.
1	3	7	1	0	89	
2	7	4	2	1	77 3/4	
3	11	1	3	2	66 2/3	
4	14	8	4	3	55 1/2	
5	18 1/2		5	4	44	4
6	22	2	6	5	33 1/3	
7	25	9	7	6	22	2
8	29	6	8	7	11	1
9	33 1/3		9	8		
10	37		10	8	89	
11	40	7	11	9	77 3/4	
12	44	4	12	10	66 2/3	
13	48	1	13	11	55 1/2	
14	51	8 1/2	14	12	44	4
15	55	5 1/2	15	13	33 1/3	
16	59 1/4		16	14	22	2
17	63		17	15	11	1
18	66 2/3		18	16		
19	70	4	19	16	89	
20	74	0 1/4	oz.			
21	77 3/4		1	17	77 3/4	
22	81 1/2		2	35	55 1/2	
23	85	2	3	53	33 1/3	

WEIGHT

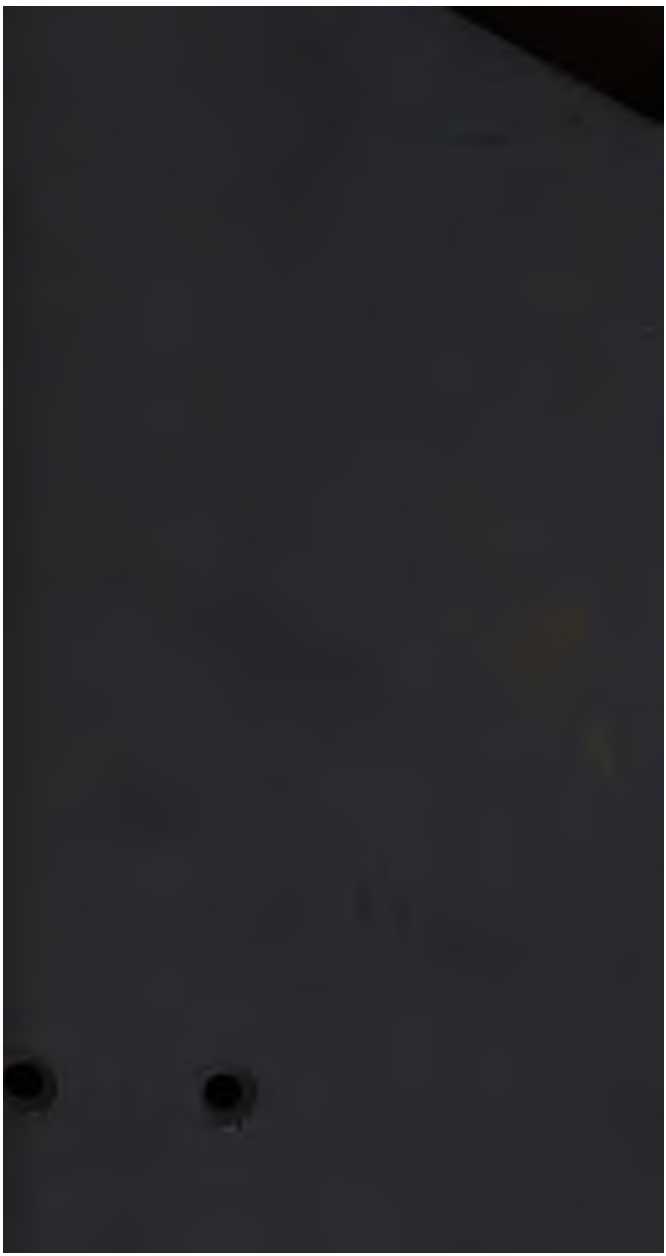
WEIGHT

WEIGHT *of French and Spaniſh Gold, in Dollars, Cents and Mills, agreeably to the Act aforeſaid.*

Grs.	*Cents.*	*Mills.*	*Pwts.*	*Dolls.*	*Cents.*	*Mills.*
1	3	6½	1	0	87	6
2	7	3	2	1	75	2
3	11		3	2	62¾	
4	14	6	4	3	50	3½
5	18	2½	5	4	38	
6	21	9	6	5	25	5½
7	25	5½	7	6	13	1½
8	29	2	8	7	0	7¼
9	32	8½	9	7	88	3
10	36½		10	8	76	
11	40	1½	11	9	63½	
12	43	8	12	10	51	1
13	47	4½	13	11	38	7
14	51	1	14	12	26	3
15	54¾		15	13	13	9
16	58	4	16	14	1½	
17	62	0½	17	14	89	0½
18	65	7	18	15	76	6½
19	69	3½	19	16	64	2½
20	73		*oz.*			
21	76	6½	1	17	51	8½
22	80	3	2	35	3	6½
23	83	0½	3	52	55½	



WEIGHT of *French and*
and Milk, agree

Grs.	Cents.	Mills.
1	3	6½
2	7	3
3	11	
4	14	6
5	18	2½
6	21	9
7	25	5½
8	29	2
9	32	8½
10	36½	
11	40	1½
12	43	8
13	47	4½
14	51	1
15	54½	
16	58	4
17	62	0½
18	65	7
19	69	3½
20	73	
21	76	6½
22	80	3
23	83	0½

Daves.